Radio, Electronics and Communications

FORMERLY "RADIO & ELECTRICAL REVIEW" — WIDELY KNOWN SINCE 1946 AS "R. & E."

In This Issue . . .

PUBLISHED MONTHLY IN THE INTERESTS OF THE N.Z. ELECTRONICS INDUSTRY FOR ALL LEVELS, FROM PROFESSIONAL TO AMATEUR.

VOLUME 19 NUMBER 11

JANUARY 1, 1965

PRICE 2/6

ENQUIRY CARD AD. 1

ENQUIRY CARD AD. 2

with counter ease and accuracy

The new Hewlett-Packard 5254A Frequency Converter, $825, extends the measurement range of the 5245L Counter to 3000 mc, with full counter accuracy and performance. It's the newest example of the plug-in versatility of the counter, which offers a basic maximum counting rate of 50 mc, with 8-digit resolution.

The new converter operates on the heterodyne principle, subtracting a selected multiple of 50 mc from the input signal. Direct measurement is simple, with the measured frequency equalling the sum of the counter reading and the value indicated by the 5254A dial. Input signal level is 50 mv rms to 1 v rms. Spurious signals have been virtually eliminated. Smooth, backlash-free tuning and a level indication meter enable untrained personnel to make quick, easy measurements to full counter accuracy.

Here's a brief summary of the features delivered with the basic 5245L Counter for $3250:

Time base stability better than $3/10^9$/day
Display storage for continuous display
Automatic display of measurement units
Four-line BCD output for systems, recorders
Compact modular cabinet only 5¼" high

THESE PLUG-INS AVAILABLE TODAY . . .
MORE TO COME!

5253B Frequency Converter to 500 mc, $500
5254A Frequency Converter 300 mc to 3000 mc, $825
5261A Video Amplifier for 1 mv rms sensitivity, $325
5262A Time Interval Unit, 1 μsec to 10^8 sec, $300
5264A Preset Unit—for measuring N x frequency, period, ratio, time N events, divides input by N, with N = 1 to 100,000 selectable, $650
5265A DVM plug-in—six-digit measurement of dc, 10, 100 or 1000 v full scale, accuracy 0.1% of reading, $575

Call or write for further information.

HEWLETT PACKARD

An extra measure of quality

Data subject to change without notice.

SAMPLE ELECTRONICS (N.Z.) LTD.

8 MATIPO STREET, ONEHUNGA, S.E.5, AUCKLAND, NEW ZEALAND TELEPHONE 565-361

ENQUIRY CARD AD. 3

SQ *Special Quality tubes for industrial equipment*

Latest frame-grid technique betters HF performance

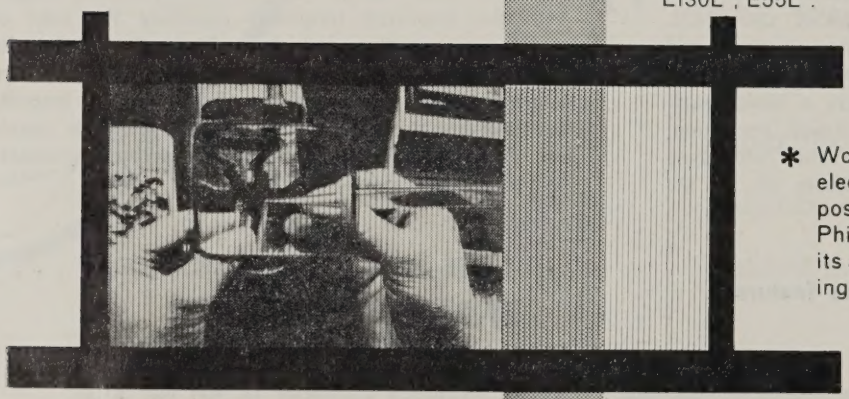
The use of electron tubes in industry is expanding from day to day. New applications and improvements in existing applications more than ever require utmost reliability. Therefore Philips developed the Special Quality series.

In the field of HF-applications, favourable characteristics are also of great importance. Philips therefore elaborated and perfected the frame-grid technique (more windings with only 10, 8 or even 5 micron thin wire!), realising:

- higher mutual conductance
- less microphony
- smaller spread in characteristics
- life-long stability

The application of the frame-grid technique in SQ-tubes realises a valuable series of tubes for almost any industrial HF application:
E88CC, E188CC, E180F, E186F, E810F*, E130L*, E55L*.

*dual frame-grid



Assembling the tube systems in precision jigs

✱ Worldwide know-how of electronics at your disposal. Contact the Philips organisation for its application engineering service.

	max. anode dissipation W	anode voltage V	anode current mA	amplification factor	mutual conductance mA/V
E88CC(6922)	1.65	100	15	33	12.5
E188CC(7308)	1.65	100	15	33	12.5
E180F(6688)	3	190	13	50	16.5
E186F(7737)	3	190	13	53	16.5
E810F(7788)	5	135	35	57	50
E130L(7534)	27.5	250	100	6.5	25
E55L	10	140	50	30	45

PHILIPS

PHILIPS

MINIWATT

NUCLEUS OF INDUSTRIAL ELECTRONICS

Radio, Electronics and Communications

Formerly Radio and Electrical Review
(Established 1946)

CONSULTANT EDITORS:
C. W. Salmon, M.N.Z.I.E., Grad. I.E.E., Assoc. I.E.R.E.
I. H. Spackman, A.M.I.E.E.E.
P. L. Watts representing N.Z. Electronics Institute

EXECUTIVE EDITOR:
Robin H. E. Beckett.

* * *

Published Monthly by the Proprietors:
THE MAGAZINE PRESS LTD.,
Publishers also of HOME AND BUILDING

Director and Chairman:
Victor L. Beckett A.A.I.(Aust.), Hon.A.N.Z.I.A.

Director and Secretary:
Wilma W. Beckett

Production Manager:
Robin H. E. Beckett, B.A.

at the Registered office of the company, Employers Association Building, 157 Khyber Pass, Auckland, C.3. N.Z. P.O. Box 1365, Auckland. Telephone 41-508, 41-519.

OFFICIAL JOURNAL OF
The New Zealand Electronics Institute (Inc.)
Secretary: J. L. McKie, P.O. Box 1506, Christchurch.

* * *

Sole New Zealand Distributors:
GORDON & GOTCH (N.Z.) LTD.

From Newsagents — 2/6 per copy. Or direct from the publishers 30/- per year in advance, post free throughout the world.

* * *

Advertising Representatives for the United Kingdom:
PUBLISHING & DISTRIBUTING CO., LTD.,
177 Regent St., London, W.1.

* * *

Printed by Farrell Printing Ltd., Mt. Roskill, Auckland. Registered as a newspaper at the G.P.O., Wellington.

Vol. 19, No. 11 January 1, 1965

CONTENTS

On Our Cover

ALL PURPOSE MICROPHONES FROM AWA

This month's cover shows a selection of world-renown AKG microphones now available through Amalgamated Wireless (Australasia) N.Z. Ltd. Of acoustically perfect design and lightweight, streamlined construction, these microphones give professional brilliance to home recordings while also being ideally suited to studio use.

Microphones illustrated are:

D7A Dynamic, high sensitivity, hand-held microphones ideal for home recording. Features plug connections for high and low impedance tape recorder inputs. Frequency range: 80-11,000 cps.

D11N Dynamic directional microphone. Special cardioid characteristic allows echo-free speech and music recordings in acoustically unsuitable locations, also eliminates background noise and facilitates sound dubbing. Built-in speech-music switch alternates sensitivity at low frequencies on close talking. Frequency range. 80-13,000 cps.

D19E Dynamic cardioid combi microphone is rugged and light. Self-contained base switch adjusts for "speech" positions. Effective magnetic shielding allows good pick up at even very low sound levels. Separate matching transformer available for added flexibility. Frequency range: 40-16,000 cps.

K58. Headphone/microphone combination. World famous K50 headphones combine with new AKG D58 dynamic anti-noise microphone to make this unit ideally suited for audio/visual teaching, intercommunication systems, control centres, etc., where microphone is to be used near loudspeakers. Frequency range: Headphones, 20-25,000 cps.; microphone, 100-12,000 cps.

These AKG microphones cover every recording need and are of exceptional quality. Enquiries are welcome to AMALGAMATED WIRELESS (AUSTRALASIA) N.Z. LTD., Auckland, Wellington, Christchurch and Dunedin.

COMING . . .

R.E. & C. 6" Experimenters, Television Receiver-III
Medium Power Semi-conductor Rectifiers
N.Z. Electronics Institute. News and Plans for 1965
N.Z. Science Congress — Report
Shortwave Notes — Resuming Shortly

Also . .

Circuit and Service Data
Book Reviews
New Products
Serviceman's Column

Letters from Readers

Sir,

Would you please send me "Radio Electronics and Communications" for two years starting with the July 1964 issue, for which I enclose my cheque for £3.

I have considered making the sweep oscillator described in the July 1963 (page 14) issue but am dubious about the accuracy of the component values shown in the circuit, suspecting a misprint. The D.C. voltage applied to the BA 102 diode with P2 and P1 in their most positive positions would appear to be destructive at about 150V and even so at half this at their central positions. Figure 5 suggests that the voltage should centre around 4V with a maximum of 20V. The coil data on page 39 appears to confuse the specifications for L1 with those for L2. Would linearity of output be improved if the coils were shunted with resistors? Only wirewound pots of 5K seem to be available for the attenuators. Have these been found to interfere with level output through self inductance? If you could find space to print a photograph of the wiring side of the chassis I am sure it would speed work for others undertaking the job of duplicating Mr. Johnson's versatile instrument. Even the article "Speculations on a sweep generator" in the April 1964 issue was coy in this regard.

Many thanks for an interesting article.

Yours faithfully,
E. GOODCHILD.

Sir,

In your July 1963 issue there appeared an article and circuit of a TV. alignment instrument using a BA102 variable capacity diode in the sweep oscillator. The published data on this diode shows a maximum voltage of 20v. whereas the circuit published would apply considerably more DC voltage than this at some positions of the centering control, on top of which is imposed the sawtooth sweep voltage. When in Wellington recently I enquired from Messrs. Philips Electrical Industries Ltd. re any revision of the limits but they knew of none.

It would also seem that the coil data on page 39 for L1 and L2 may be mixed as the coil intended to oscillate at channel frequency has more turns than that intended for the vision I.F.

Trusting you may be able to throw some light on these two points.

Yours faithfully,
R. D. LEE.

After consideration of the published circuit it appears that your fears could be justified. Discussions with others who have built this equipment indicate that for various reasons such as using lower supply voltage line than specified there have been no failures of the BA 102 to date. Reference to the published data on the BA 102 gives a maximum peak inverse voltage of 20V. We have investigated an actual unit and quote the following details. Supply line voltage 180V. Voltage across the diode with adjustment of centring control is 0 to 27 volts with sweep width in centre position. Variation of sweep width control only changes the maximum voltage of the diode by a volt or two at the most.

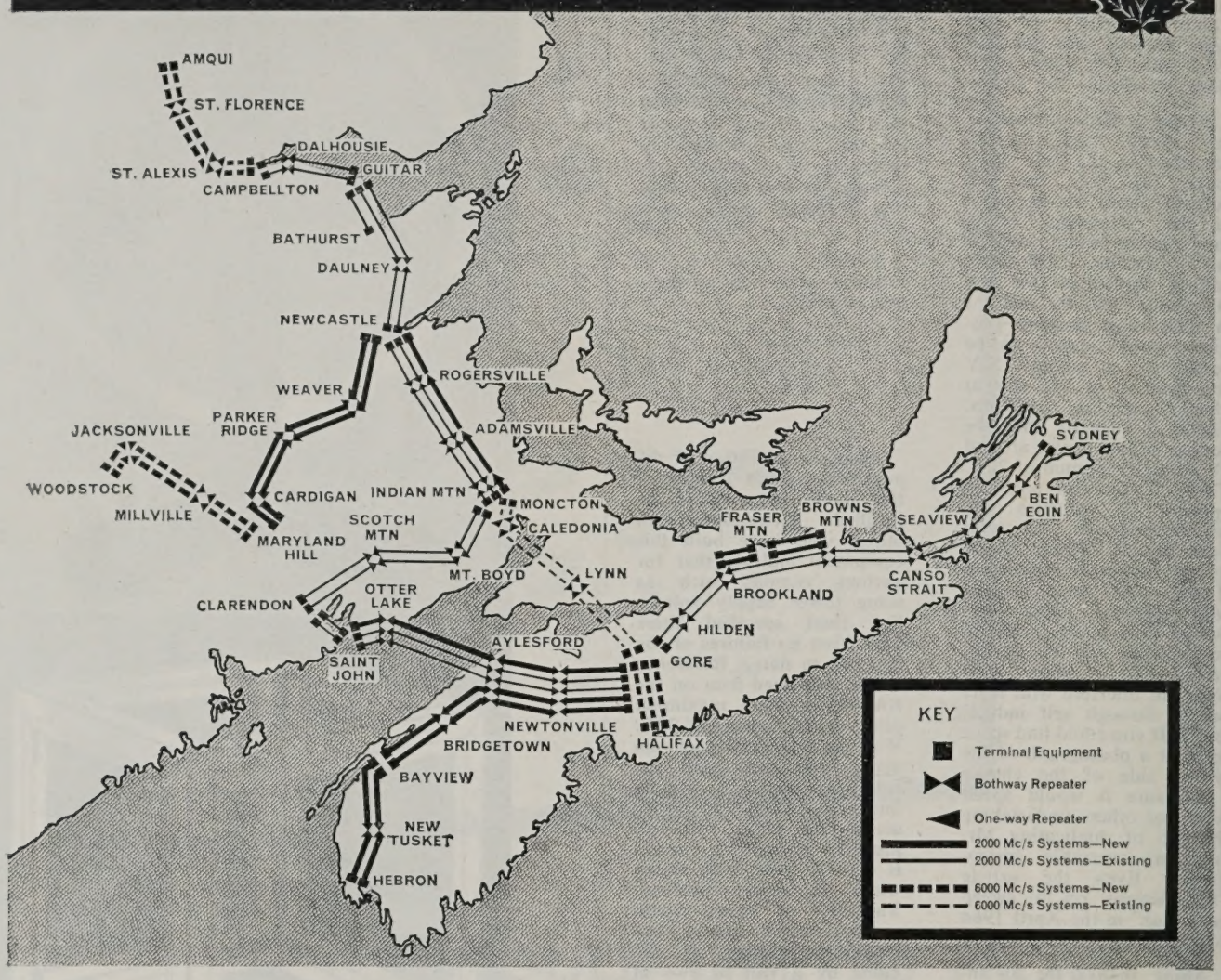
In view of this a simple suggested circuit modification would be to increase the values of the resistance between the top end of centering control and H.T. line to say 250K ohms. With regard to tuning range of the various coils it is probable that the slug tuning range will take up any differences. However, with regard to this and the other queries we have forwarded copies of these letters to the author of the article for his comments and hope to be able to publish these next month.

—Ed.

ENQUIRY CARD AD. 7

G.E.C.

FURTHER ADDITIONS TO THE MICROWAVE COMPLEX IN EASTERN CANADA



Expansion of the networks operated by The New Brunswick Telephone Company, the Maritime Telegraph and Telephone Company and the Quebec Telephone Company has resulted in further large orders for both UHF and SHF radio relay and the associated voice multiplex equipments. The extensions now on order will provide the network with additional 360 television channel/miles and 230,000 speech circuit/miles.

The radio and multiplexing equipments used will be manufactured by GEC (Telecommunications) Ltd and supplied and installed by Canadian General Electric Company.

The new extensions will employ customer proven GEC microwave equipments operating in the 2000 Mc/s and 6000 Mc/s frequency bands, and transistored multiplex equipment.

For further information on the radio and multiplexing equipments please write for Standard Specifications SPO 5555, SPO 5502 and SPO 1372

everything for telecommunications

G.E.C.

TRANSMISSION DIVISION
G.E.C. (TELECOMMUNICATIONS) LTD
TELEPHONE WORKS · COVENTRY · ENGLAND · *Works at Coventry and Middlesbrough*

103

FAIR AND REASONABLE

Human nature being what it is, whenever shortages occur there are those who will profit by them and those who will suffer because of them. There has been considerable discussion in Government circles over the past six months or so concerning trafficking in import licences. Careful reading of the various press reports leaves the impression that "trafficking" is taken to mean the transfer of import licences, unwanted by the donor, at excessive rates of "interest".

Within the electrical and radio industry, and no doubt in others, there are equal evils that are not labelled "trafficking" and it is the small user who is suffering in this case rather than the general public. One common rejoinder today is "provide your own licence." This has two variations. The importer (agent) will assist with evidence that he cannot provide a licence himself and therefore back up the purchaser's case to the Customs Department or the importer will smugly sit back, merely acknowledge the order, and await your providing the licence. This latter case is the one that the Customs Department could well investigate in some detail. Whilst many licence holders follow Government directives by using licence for stock lines to satisfy general demand it is difficult to believe that full licences are used up only three months after issue.

Not only do many intending purchasers have to undertake their own licence applications but no price reductions are offered in most cases by the agents when the purchaser provides the licence. When the agent undertakes the time consuming business of dealing with the Customs Department it is only fair that his commission should include this but some deduction should be made if the purchaser does this work instead. If the agent can retain his licence for stock (at greater profit margin) then any additional "licence provided" orders are sheer jam on the bread and should be priced accordingly, especially as increased orders will enhance the agent's reputation with his principals and, in some cases, enable him to retain a shaky agency against competition.

Similar hunger for unreasonable profit is apparent in offers and tenders where there is little, or no, competition. In an allied field, that of electronic office equipment, someone was recently offered special copying equipment on the basis "licence your care." The quoted price £1180, the profit content £303. The agents in this case were not even prepared to arrange credit with their principals as all financing and shipping had to be arranged by the intending purchaser.

Now, admittedly such a case is not trafficking in the sense meant by Government Departments but it still would be unfair and unreasonable profit because of licence shortage producing a shortage of goods.

What is the remedy? Various remedies have been suggested, ranging from suspension of all licences and issuing every licence on an individual basis to removal of import control and the application of duties in its place. The first would impose an intolerable burden and produce a mass of paperwork and the second would undoubtedly further weaken our overseas funds. One system that has been mentioned to us by an importer could have merit. To substantiate the need for import licences in the 1966/67 year a copy of every order placed in the 1965/66 import year would be attached to the 1966/67 application. By these the Department would easily see how much of the licence was genuinely used and how much "sold off." This would involve licence holders in a minimum of work as only an additional carbon copy and an order is needed.

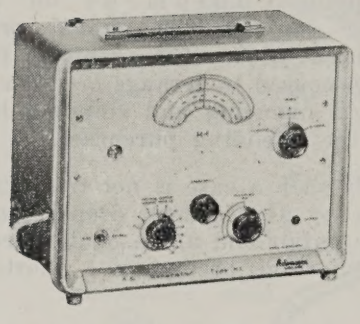
The sad fact is, however, that no such checks should be needed. To some extent those in the industry can remove the evils of licence trafficking and excess profits by NOT accepting propositions known to be unfair.

Where agency material or components are concerned a direct approach to the overseas principal usually does wonders. Grossly unfair dealings are within the interests of the Department of Industries and Commerce (Trade Practices Division).

It is only a very small segment of the industry that is seeking capital out of the present situation and a good house cleaning by one of the industry's associations would not go amiss and would, no doubt, be appreciated by the Government as a welcome change from the usual bleats about import control.

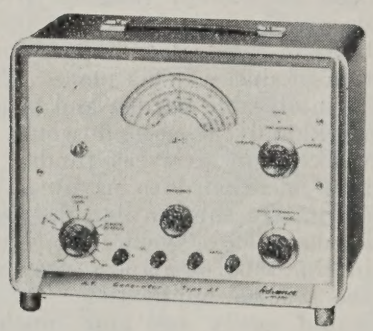
ENQUIRY CARD AD. 8

Advance l.f. signal generators



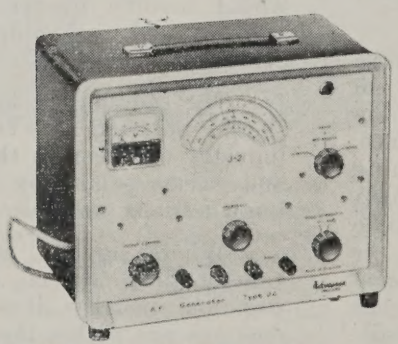
H1 Audio Signal Generator

Frequency range 15c/s to 50kc/s in three bands. *Accuracy* ± (1% + 1c/s). *Sine wave distortion* Less than 1% at 1,000c/s. *Output* Sine wave continuously variable, 200μV to 20V ±2dB. Square wave continuously variable, 400μV to 40V, i.e. 800μV to 80V pk.pk. *Power requirements* 105 to 125V, and 210 to 250V, 40 to 100c/s, 30W. *Dimensions* 13½in (34·3cm) wide × 10¼in (26cm) high × 8in (20·4cm) deep. *Weight* 14lb (6·4kg).



J1 Audio Signal Generator

Frequency range 15c/s to 50kc/s in three bands. *Accuracy* ± (2% + 1c/s). *Measured distortion* Better than 34dB down (2%) at full output, better than 40dB down (1%) at 0·1W (as compared with fundamental above 100c/s). *Output* Continuously variable 0·1mW to 1W (0·25V to 25V) ±2dB into 600Ω. *Output impedance* 600Ω or 5Ω. *Power requirements* 105 to 125V, and 210 to 250V, 40 to 100c/s, 40W. *Dimensions* 13½in (34·3cm) wide × 10¼in (26cm) high × 8¼in (21cm) deep. *Weight* 20lb (9·1kg).



J2 Audio Signal Generator

Frequency range 15c/s to 50kc/s in three bands. *Accuracy* ± (2% + 1c/s). *Measured distortion* Better than 34dB down (2%) at full output; better than 40dB down (1%) at 0·1W (as compared with fundamental above 100c/s). *Output* Continuously variable 0·1mW to 1W (0·25 to 25V) ± (1dB + 1·5% F.S.D.) into 600Ω. *Output impedance* 600Ω or 5Ω. *Power requirements* 105 to 125V and 210 to 250V, 40 to 100c/s, 40W. *Dimensions* 13½in (34·3cm) wide × 10¼in (26cm) high × 8½in (21cm) deep. *Weight* 20lb (9·1kg).

ADVANCE ELECTRONICS LIMITED ENGLAND

Sole New Zealand Representatives

TURNBULL & JONES LTD.

Auckland Wellington Christchurch Dunedin

FROM THE COMPREHENSIVE RANGE OF Advance INSTRUMENTS AND EQUIPMENT

Medium Power Semiconductor Rectifiers

An article from the National Audiology Centre* of the N.Z. Department of Health.

Whilst a particular recent interest of the laboratory was in the charging of capacitors, for spot welding of fine wires, it seemed as if there is no great wealth of published material on medium power rectification available to the average New Zealand technical reader. During the course of design of the particular equipment required a fair collection of written papers was examined and it is felt that a resume of this material would be of use.

Capacitive leads present a particular case and the more general case of resistive loads is examined in detail. In addition, the various types of single phase rectifier circuits are examined as are various types of rectifier cells.

General Introduction

As the definition of power handling capabilities varies within the electrical industry it is as well to indicate that "medium power" as given in the title is meant to include rectifiers within the 1 Amp. to 50 Amp. and 10 volt to 100 volt ranges; in other words, up to 5 KVA rating. In power engineering parlance this is low power. However, to the general reader it is hoped, say, that 1 KVA is medium power, 10 VA lower power and 100 KVA tending to high power. Despite this restriction, nevertheless, many of the limitations mentioned below apply to the rectifiers indicated over all power ranges.

Apart from valve rectifiers (mainly arc) and small rotary sets the main types of rectifiers available in our chosen range are:

(a) Selenium
(b) Silicon
(c) Germanium

and it is necessary to have some knowledge of their capabilities and limitations so as to be able to choose the best for the job in hand. In New Zealand, a further consideration enters into a possible choice — availability and delivery time for the manufacture of special rectifier stacks. However, the increasing availability of silicon rectifier cells on the New Zealand market has meant that higher voltage units have become more freely available. For this reason a silicon rectifier may be used where a selenium stack would be called for by other considerations.

Rectifier Cells

The principal properties of rectifier cells are:

(i) size
(ii) weight
(iii) life
(iv) ageing
(v) losses
(vi) cooling required and operating temperature
(vii) series or parallel operation.
(viii) overload capacity
(ix) environmental effects
(x) efficiency of the overall system

(i) Size

There is little doubt that, except for low currents and voltages, silicon and germanium rectifiers occupy far less space than selenium units. There is one point to watch, however; any forced cooling plant required may occupy considerable space. In this article no account is taken of forced cooling as all cooling is considered to be by natural convection and radiation.

(ii) Weight

Here there is little to choose between the three types—silicon and germanium are slightly lighter than selenium. When surge suppression equipment is needed this advantage may disappear, as may the size advantage.

(iii) Life

In this case the advantages are distinctly with the silicon and germanium types **provided** they are run within their temperature rating. The reading of various published data indicates that a life of 8-10 years can be expected from a selenium cell before **replacement** is required due to ageing or lack of ability to reform after damage (see (viii) below). Data published on silicon cells re life versus temperature (see figure 1) indicates that a life of better than 40 years can be expected. Theoretically the life is indefinite but this presupposes that no voltage transients or overloads (i.e., temperature pulses) will ever occur. Certainly carefully designed silicon and germanium units should have a life of 40-50 years. Put another way, these two will provide rectifier life beyond the economic life of the whole installation in that either the process involved with the DC supply will be then uneconomic in its present form or some other part of the plant will need replacement—perhaps the transformer—and economics will scrap the whole.

(iv) Ageing

Selenium cells exhibit an increasing forward resistance throughout their life. In this context life is defined usually as the time taken for the forward resistance to double, say, its initial average value (that of over the first few months of operation). Users of selenium cell battery chargers will notice this as a gradual decrease in the maximum current available. (Some battery chargers have adjustable limiting or ballast resistors to take this increased cell resistance into account).

Early silicon and germanium cells did, in a few isolated instances, offer increased forward resistance with age but this was found to be due to poor sealing in manufacture.

Present day silicon and germanium cells exhibit negligible increase in forward resistance with age.

* Prepared by the Acoustics Laboratory, 70 Symonds St., Auckland, C.1.

(v) Losses

In practice the principal loss is the forward loss, i.e., the voltage dropped across the cell at rated current. The type of load has some bearing on the drop across a cell on account of the waveform shape (i.e., the departure from sine wave shape). However, the difference is seldom more than 10%.

Average values are:
Selenium 1.8 volts/cell
Silicon 1.0 volt/cell
Germanium .5 volt/cell

Not only is the drop per cell lower in the case of silicon and germanium but the "working" voltage per cell for these is somewhat higher—by from 2 to 10 times that of selenium. The commercial grade of selenium cell used in ordinary industrial practice has a peak inverse voltage rating of about 50 volts whereas some silicon cells have a PIV of 600 volts to 1200 volts.

It is worth noting, at this stage, that some recently published literature uses the term "crest working reverse voltage" in place of the more familiar Peak Inverse Voltage. The newer term is abbreviated CWV. A further term is sometimes also used—Maximum peak transient reverse voltage, PTV. This is usually 20% higher than the CWV.

Thus it will be seen that the voltage drop in, say, a unit for 500v CWV may be:
for Selenium, 10 cells x 1.8v = 18v.
for Silicon, 2 cells x 1.0v = 2v.
(using 2 cells for safety)

For a 10 amp. load, not taking other factors yet to be discussed into account,

Selenium has a rectifier loss of 180 VA.
Silicon has a rectifier loss of 20 VA.

Thus, for the same terminal output the transformer for the selenium unit would need an additional 16 volts, or 160 VA of capacity.

However, for rectifier units for low voltages, say CWV of below 50 volts, such as battery chargers, the difference of the cell voltage drop between selenium and silicon or germanium is negligible when only 1 cell (per rectifier arm) is involved. Thus, for non critical use at low voltages, cell losses may not be important.

(vi) Cooling and Operating Temperatures

Users of transistors for audio power purposes will know the care needed to ensure operation within rated temperatures. It would be sufficient to say here that the same regard to manufacturers' recommendations should be kept were it not for the fact that temperature reflects on certain other properties under consideration. In critical design the principal of these is life. When designing for a "tight" situation it is permissible to increase the operating temperature at the expense of life **provided** all other factors are under control and reliable figures are available from the manufacturer for life derating purposes. On the other hand, and towards safer design, it is useful to know, say, the increase in life due to reducing the current or reducing the ambient temperature. (The former will probably cause the latter but ambient conditions will also effect the latter).

Figure 2 shows the effect of both ambient temperature and current upon a typical selenium rectifier. It will be seen that there is no real advantage obtained by reducing the current below the rated value. On the other hand the life is approximately halved for a 50% current increase. A 20° C ambient temperature rise will likewise halve the life.

Current for current selenium cells have a greater junction contact area and thus better heat conduction properties than silicon and germanium rectifiers. Because of this temperature has greater bearing on the life of these cells.

A selenium cell has a good chance of surviving a sudden, but short, temperature rise due to some outside load condition or supply peculiarity but unfortunately the same cannot be said for silicon and germanium. Figure 1 shows the relationship between **junction** temperature and life. As mentioned earlier, this curve can be used to show an indefinite life under temperature limited conditions. The curves of figure 2 do not show the same tendency however. The selenium curves have been drawn to take into account the inevitability of replacement of industrial grade selenium cells due to ageing.

The junction temperatures of silicon and germanium cells should be kept down to 150° C and 85° C respectively by means of suitable heat sinks. These will usually be specified, or supplied, by the manufacturers of the rectifier cells. At the other end of the scale, the minimum temperature should not be below −40° C.

Whilst the reverse conditions will not be dealt with so far as leakage currents are concerned it is worth noting that increasing junction temperature in Si and Ge causes a rapid increase in reverse leakage current. This is dangerous in that the CWV (PIV rating) is reduced as the temperature is increased. In practice the point of no return can be reached very quickly indeed!

Further correlation can be achieved by studying figures 3 and 4 in conjunction with figure 1.

(vii) Series of Parallel Operation

As medium powers only are being dealt with and the voltages under consideration later will not be greater than a few hundred the range of both germanium and silicon cells at present on the New Zealand market will obviate the need for series or parallel operation in most cases. Nevertheless, as both connections have inherent problems these should not be overlooked.

(a) Series Operation

In the forward direction each rectifier cell (of a series string) carries the same current and the voltage drop across each cell will be almost the same—there will certainly be no great potential differences. In the reverse blocking condition the voltage across each cell will depend upon the reverse leakage current. Leakage currents vary from cell to cell and, as importantly, they vary with the temperature of the junction. In practice, it is possible that one cell will run many tens

of degrees hotter than another not due to cell defects but because the rectifier has been either improperly screwed down on its heat sink or because of vagaries in the cooling conditions. The spread of reverse leakage current with respect to temperature appears to be greater in germanium rectifiers and this is worsened by the generally lower operating temperatures of germanium devices in any case. With silicon rectifiers the leakage current starts to run away only near the maximum temperatures for the junction (say 150° C to 185° C). Figures 5 and 6 show the variation in both forward and reverse currents with respect to temperature.

To ensure that grossly unequal voltages do not appear across series cells it is necessary to connect a resistor (of high value) across each cell the value being chosen to limit the voltage across the cell to less than the CWV (PIV). In the state change from conduction to reverse bias the cell takes a definite time to achieve this state depending upon the stored charge. This varies from cell to cell and the rectifier cell with the least stored charge recovers first and is subject to the full reverse voltage. In some cases a capacitor is also connected across the rectifier for such transient protection.

The calculation of series resistors will be given in an appendix at the conclusion of these articles as the likelihood of readers using long series strings is not high and the calculations do not warrant space at this stage of the discussion. The capacitor value calculation is somewhat complex also—generally it is satisfied with quite small values, seldom values more than .1 μF are required in the largest industrial installation and in the medium power work under consideration values of .001 μF would be appropriate.

(b) Parallel Operation

In our power range this method of connection is more likely to occur than series strings and fortunately presents fewer theoretical problems. As no two

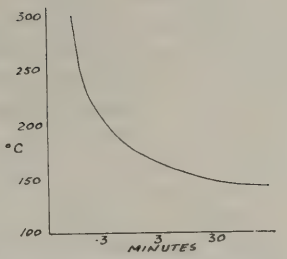


FIG. 1 — Temperature of Junction versus life for small silicon cell.

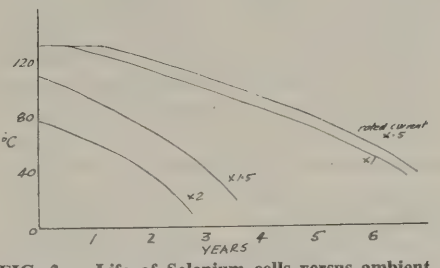


FIG. 2 — Life of Selenium cells versus ambient temperature for various values of operating current.

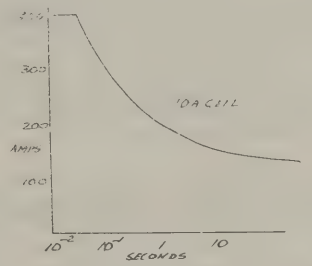


FIG. 3 — Life versus peak current for selenium cell.

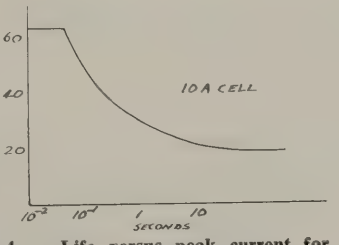
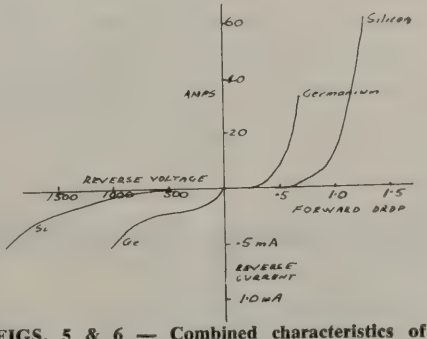


FIG. 4 — Life versus peak current for Germanium cell.



FIGS. 5 & 6 — Combined characteristics of silicon and germanium diodes combined.

rectifiers are identical either in characteristic or in "mechanical connection" losses it is inevitable that one rectifier in a parallel connection will tend to have a better forward characteristic than its mate (or other mates). Because of this it will share a greater portion of the load and a resultant temperature rise above that intended may occur.

This defect can be allowed for by derating the cells for current and temperature so that an unexpected rise still means that the final operating temperature is not exceeded.

Another method is to mount all paralleled cells on the one heat sink so that all junctions tend to reach (and keep at) the same temperature so that the individual characteristics at least stay in step.

Some users of cells (whether selenium, silicon or germanium) place a small resistance in series with each cell to stabilise the forward characteristic but this is an essentially wasteful method.

The use of fuses in parallel circuits should be carefully studied as a short in one parallel leg will blow the fuse in that leg and place a greater current drain on the other paralleled rectifiers. Fast acting fuses are essential and high breaking (rupturing) capacity cartridge fuses are usually employed having a fusing factor of 1.5 times the cell rated current. Transient surges due to the opening of a fuse after a cell short circuit (i.e., a sudden rise in voltage) can also be troublesome.

(viii) Overload Capacity

It is often said that silicon and germanium cells are inferior to selenium in their capacity to cope with sudden overloads and it is true that such a simple statement is correct. The **novice** designer expecting unknown load surges would do well to stay with selenium cells unless he has some inkling of the magnitude of the overloads.

A selenium cell subjected to a reasonable overload (3, 4 or 5 times) for a 20 or 30 seconds will usually survive whereas a silicon or germanium may not.

Selenium cells also have a property of "healing" after a moderate fault, particularly of transient nature. Because of this selenium has advantages where the transient conditions are not known. However, as will be seen later adequate circuit design will give good transient protection to silicon and germanium cells.

Current overloads of a **predictable** nature in silicon or germanium equipment can be allowed for in design as the characteristics of these cells under a wide range of temperature and overload conditions are known to the manufacturers (and published by them). Application of the cell behaviour (under overload conditions) from published data can be applied so as to provide the required factor of safety.

Figures 3 and 4 show the overload/time characteristics of two types of cells. Unfortunately no similar curve can be found for selenium although figure 2 gives an inkling of the better characteristics of selenium under loads 2 or 3 times rated load.

(ix) Environmental Effects

Here selenium is the poorer due to the type of construction used by most industrial manufacturers. The usual selenium rectifier cell is "open", i.e., not **hermetically** sealed. Although paint or varnish is used to seal the assembly, in time this cracks or is made pervious by temperature cycles. This then allows moisture or corrosive atmospheres to enter and attack and weaken the cell with ultimate failure. Epoxy resins are one method of improving the seal of industrial grade selenium rectifiers. (In passing, we deprecate the lack of seal by one New Zealand assembler of selenium cells—no paint, no varnish, no 10-year life either!).

The complete seal of silicon and germanium cells ensures freedom of attack from the atmosphere against the rectifier **junction** itself. Failure from attack by corrosive fumes against the cell proper would still be needed.

Immersion in an oil bath is the conventional method of protection from corrosive or damp atmospheres and is particularly useful for selenium cells. Oil tanks also are helpful in heat dissipation.

(x) Efficiency of Overall Systems

The discussion above has been centred about the three rectifier types and except for (v) "losses" no direct mention has been made of employing these rectifier cells in circuits for practical appplication.

There are four rectifier circuits available for single phase use:

A — Half wave
B — Centre tap
C — Full wave bridge
D — Voltage doubling

Each circuit has advantages and disadvantages and all four circuits can use any of the cell types mentioned above. Each circuit will be examined as an ideal circuit (i.e., with no losses) and later practical values (and losses) will be introduced leading to determination of required transformer voltages.

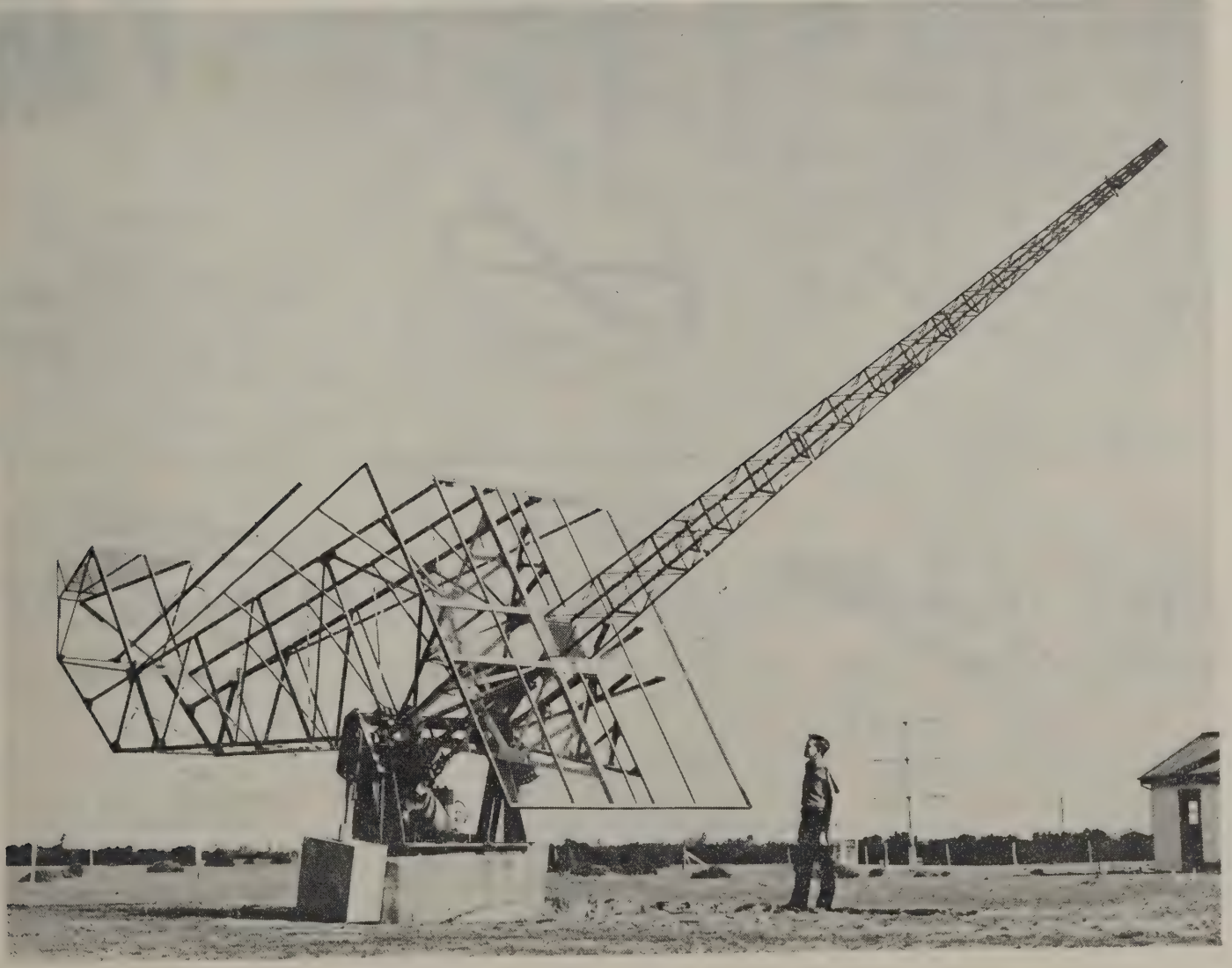
(Continued next month)

A SOLAR RADIO NOISE MONITOR

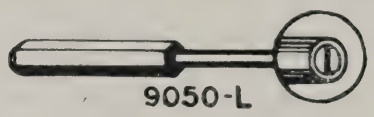
a release from R. N. Manchester, Dept. of Physics, University of Canterbury.

A large antenna system which tracks the sun during the day has been designed and constructed at the University of Canterbury Physics Department Field Station. The system is capable of monitoring solar radio noise on three frequencies, and uses Yagi antennas having three directors with a rear screen instead of the usual reflector. Buried coaxial cables are used to convey the signals to a sensitive receiver which records the incident radio noise intensity. The receiver, called a Riometer, is of unusual design with a tuned amplifier input being switched between the antenna and a reference noise diode. Servo control is used to maintain the diode noise power equal to that from the antenna, the diode plate current providing a record of the received noise power. This system provides very good long term stability.

The antenna structure is supported on horizontal shafts, the bearings for which are mounted on a turntable allowing rotation about both vertical and horizontal axes. The structure also rotates about a further axis—the polar axis—which is parallel to the rotation axis of the earth. To give the solar tracking motion this axis is made to rotate uniformly by means of a servo control system. The day to day operation of the control system is automatic, adjustments only being required at about fortnightly intervals for the seasonal variation of solar elevation.



ENQUIRY CARD AD. 10



NEW G-C ALIGNMENT TOOL FOR ZENITH

Especially designed for Zenith sets, made of new black nylon material. Has overall length of 5¾". Replaces old type 9050 alignment tool originally used on Zenith sets.

Part No. 9050-L Alignment Tool

We present a few items in the large range of GC Electronics Tools :

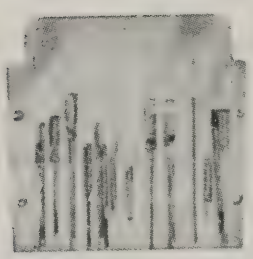
Whether it be ALIGNMENT - RIBBON - VALVE EXTRACTOR - TEST SOCKET - TEST LEADS - OR ANY OTHER TOOLS GC makes them — and makes them better.

Those of you who have used them for years now should know—you appreciate good tools. Tools that last.

There is a GC Tool in the range for **your** requirements so why not drop us a line.

GC ELECTRONICS — A GREAT NAME TO REMEMBER

DELUXE TELEVISION ALIGNMENT TOOL KIT



HANDY ROLL TYPE CASE WITH 16 TOOLS

Tools Are Specially Engineered for TV Sets

Case is made of durable leatherette that will give long service. Case is made with a fold-over flap to prevent tools from dropping out and getting lost.

G-C Television Tools are the best quality tools you can buy. They are made especially for television work and are all designed to give you long service. The steel tips are all extra thin and are of the best grade hardened spring steel that will give you service. Kit contains one each of 16 tools you need.

It pays to buy G-C tools because they are better.

They are used and approved by leading manufacturers of Television sets.

No. 8280 TV Kit in Leatherette Case

G-C AMO MINIATURE TUBE PULLER

Patent No. 2,607,620

"Prevents Tube Breakage and Burned Fingers"

Patented AMO was designed to prevent tube breakage, prevent burned fingers and to speed up production of radios using the miniature type tubes. AMO now makes it possible to easily remove or insert miniature tubes such as 6AG5, 50B5, etc. It works on the suction and vacuum principle.

To extract tubes, simply press AMO down on tube and lift up. Tube is then released by pressing release button. AMO will pull tubes out of the tightest sockets, where it is impossible to pull them by hand without breaking the tube. To insert tubes, into hard-to-reach places, place tube in AMO holder, press into socket and release!

G-C Low Cost TEST LINE TEST LEADS

Slender Pencil Type

Tenite 5" long test prods with 50" of high quality, kinkless test lead. Heavy duty phone tips on other end.

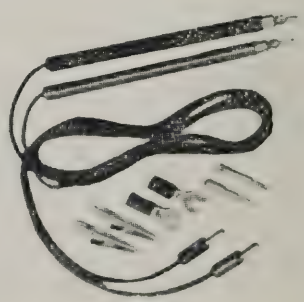
Part No. 9190

NEW G-C PRECISION 300-OHM TOOL

4 Tools in One

This specially designed tool cuts, slots, strips and crimps. Has shockproof, oil resistant plastic grips. Bites through 300-ohm line clean and fast. Makes for fast, easy installations. Will also crimp on solderless terminals.

Part No. 9220

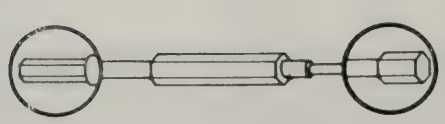


G-C UNIVERSAL TYPE TEST LEADS

With Needle Point Prods

Equipped with needle point chucks and needles to pierce insulation. Other end with standard banana plugs, interchangeable for spade lugs, phone tips and alligator plugs. Supplied with complete set of tips.

Part No. 8464

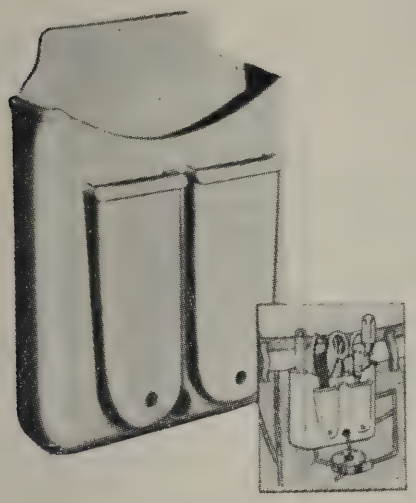


G-C ZENITH-ADMIRAL NYLON HEX WRENCH

New nylon hex wrench alignment tool for Zenith, Admiral, and other sets. Hex wrench on both ends, one end under-cut so it will reach bottom slugs in iron coils.

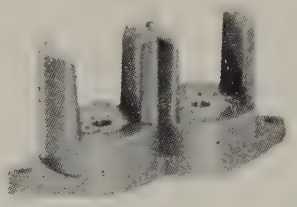
2 sizes—supplied 5" and 11" long. (.100 across Flats of Both Hex.)

No. 8606 5" Wrench



G-C TUX TOOL CASES Made of Government Developed "Alathon"

Case is flexible and tough without losing shape. Will carry your most needed tools with you. Handy as third arm. Belt attachment.

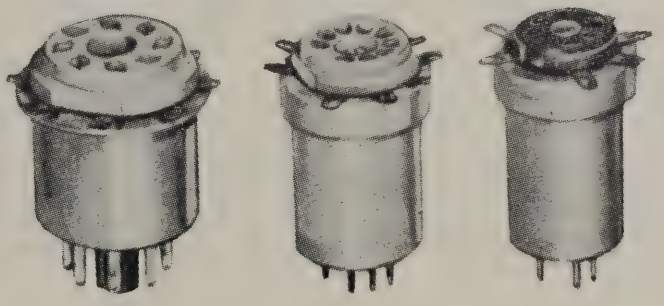


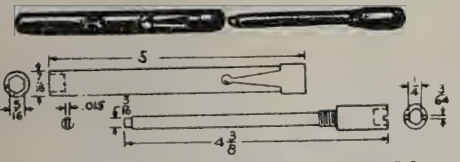
G-C DUPLEX TUBE PIN STRAIGHTENER

The handiest tube pin straightener for both miniature and jumbo miniature tubes of the 7- and 9-pin types. Pins on both types can be straightened by inserting in proper receptacle. Precision constructed steel dies moulded in colourful plastic. Be prepared to save those tubes.

G-C TEST SOCKET ADAPTERS

G-C Test Socket Adapters are handy for making tests and measurements of voltage, resistance, video, and audio from the top of the chassis.





G-C 4-in-1 ALIGNMENT TOOL

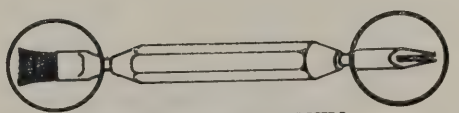
This is the most popular alignment tool for most receivers. Made of Bone Fibre, combination tool. Consists of Screw Driver with metal nib, ¼" Hex Wrench slotted and 5/16" Hex Wrench on other end.

No. 5014 Tool

SOLE AGENTS . .

P. H. ROTHSCHILD & Co. Ltd.

83 PRETORIA STREET LOWER HUTT P.O. BOX 170 TELEGRAMS "FRANDS"

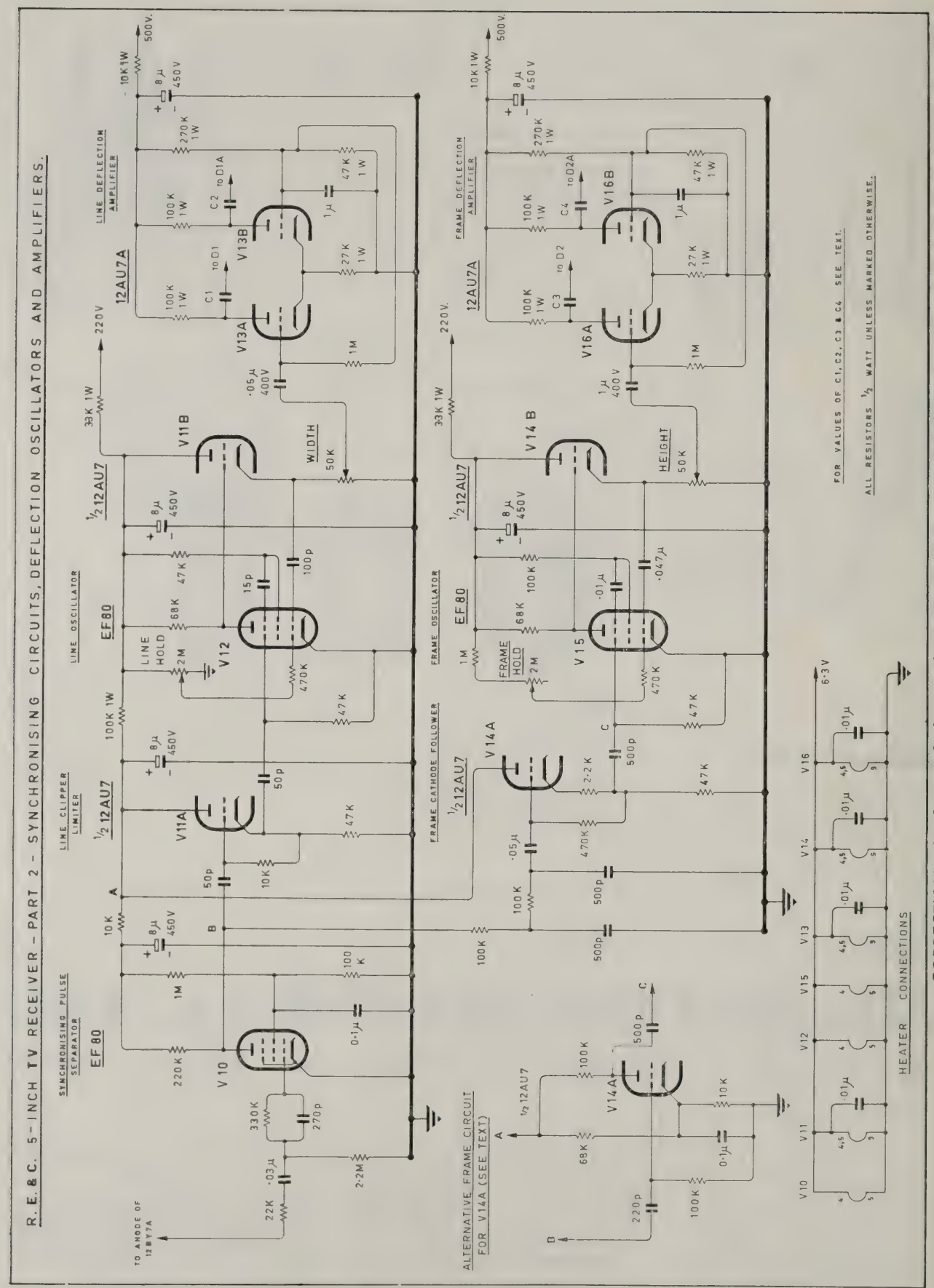


G-C HEAVY DUTY SOLDERING AID TOOL

"WITH THE WIRE CLEANING BRUSH"

Made of special stainless steel with hardened probe. Solder will not stick to it. One end has a stiff wire brush for cleaning wire and terminal strip before soldering, and the other end is machined to hold the wires while being soldered. Solder will not stick to the soldering probe end of the tool. Length 8".

Part No. 9088 Soldering Aid Tool



CORRECTION: In front of the Grid circuit of V10 are the words "To anode of 12BY7A". This should of course read "To Anode of EF184" and is a legacy from earlier developments.

R. E. & C. Experimenters 6" Tv Receiver

by Irving Spackman

This month, we are publishing diagramatic details to enable the experimenter or home constructor to wind the coils for the I.F. vision and sound strip, and the sound frequency trap in the Video amplifier anode circuit. We also have included the circuit details for section 2 of the receiver. This part comprises (1) the synchronising pulse separation circuits which separate the synchronising pulses from the composite video signal and process and direct the various pulses to either the line and frame timebases; (2) the line oscillator operating on 15,625 cycles per second; (3) the frame or field oscillator operating on 50 cycles per second; (4) the line deflection amplifier and (5) the frame deflection amplifier. These two latter amplifiers provide the high voltage deflection for the electrostatically deflected VCR97.

THE VIDEO-SOUND AMPLIFIER

Continuing now from where we left off in the November issue, there is one coil which we did not mention, mainly because it is not solely associated with the I.F. strip. This is coil L7. To discuss the operation of this coil, we must look at the functions of the video amplifier V6, or EF184. Readers will notice in the circuit in the November issue that the diode detector is directly coupled to the Grid of the Video Amplifier. As the signal level increases the negative voltage from the detector also increases (this is also the A.V.C. voltage) and thus the negative bias on the EF184 grid is also increased. Under these conditions the video amplifier will normally have sufficient grid bias to accommodate the full modulation of the carrier. Because of the D.C. direct coupling in the grid circuit, the average D.C. anode voltage will also bear a direct relationship to the grid voltage. Superimposed on the grid voltage and therefore on the anode voltage are all the modulation components extending from D.C. up to 5.5 megacycles per second. The video information extends from D.C. to about 4.5 mc/s, on an average, and the beat between the sound and vision carrier produces the 5.5 megacycle signal. The video amplifier has thus acted as the first stage of the second I.F. strip, the signal appearing across the tuned circuit L7 in parallel with the 300 ft. capacitance. This trap circuit also prevents the sound carrier appearing at the cathode of the picture tube and affecting the picture. The 5.5 megacycle signal is capacitively coupled to the grid of V7, an EF80 which acts as an amplifier for weak signals and as a saturated grid limiter for strong signals. (See "Looking at F.M. detectors" R.E.&C. June 1963).

THE SYNCHRONISING PULSE SEPARATOR

We shall now consider the second section of the circuit. As mentioned earlier, this comprises the sync. pulse separator, the line and frame timebases, and line and frame amplifiers.

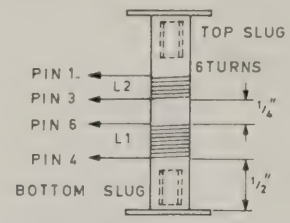
The composite video signal is applied via a 22K resistor (this should be connected close to the video amplifier anode circuit) to reduce capacitive loading on the video amplifier and an isolating capacitance (this must be of good quality with no leakage) into the grid circuit of an EF80 V.10. Included in the grid circuit of this tube is a filter consisting of a 330K ohm resistance in parallel with a 270 pf capacitance. This filter tends to pass the high frequency components of the sync. pulses and attenuates low frequency picture or noise signals which could affect synchronisation. The EF80 operates with low plate and screen voltage and zero bias. The .03 coupling capacity forms, with the resistance in the grid circuit, a suitable time constant. With input signal, grid current flows and generates a charge across the coupling capacity and bias across the grid return resistor. The effect is such that the positive tips of the synchronising pulses are clamped at earth or zero voltage, and the video signal excursions are entirely negative with respect to earth. With the low plate and screen voltages, the tubes, plate current is virtually cut off with negative grid voltages of 2 volts or more, so the video input signal must contain pulse voltages greater than this. Thus only a small amount of video information appears in the anode circut along with large but amplitude limited negative going sync. pulses. Further separation and clipping is accomplished by the following stages.

Both the line and frame oscillators utilise Miller Intergrator Transitron saw-tooth oscillators with triggering pulses applied to the suppressor grid. These triggering pulses must be negative going to achieve synchronism, so that the sync. pulse separator and any other circuitry must combine to provide such pulses.

At the output of the EF80, both the short line and longer frame sync. pulses are present. These are separated from each other by a combination of resistive-capacity filtering, or processes called differentiation and integration. The line sync. pulse, being of short duration is differentiated by the 50 pf. capacitor and 10K ohm resistance in the grid circuit of VII A. The resultant positive and negative going spiky waveform pulses are applied to the grid of this tube, being ½ of a 12AU7A, which operates as a clipper-limiter and also cathode follower. The cathode follower provides circuit isolation and prevents any stray pulses from the line timebase finding their way into the frame timebase circuits. The 12AU7 operates without grid bias, and thus the positive going spike is heavily clipped and limited whilst the negative-going pulse is passed through the tube virtually unattenuated by cathode-follower action. This is coupled to the suppressor of the oscillator via the 50 pf. coupling capacity.

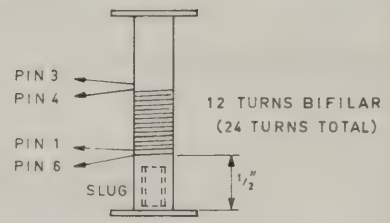
COIL DATA FOR R E & C 6" EXPERIMENTER'S TV RECEIVER.

COIL L1/L2 - WOUND WITH 30 SWG, ENAMELLED OR POLY-VARNISH WIRE.



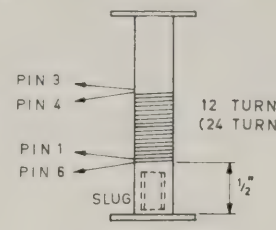
PINS 1&3 WITH 50pF CAPACITOR CONNECTED ACROSS.
PIN 4 - TO GRID AND 5·6pF CAPACITOR.
PIN 6 - TO 2MΩ A.V.C. RESISTOR, 1000pF CAPACITOR & CENTRE OF COAXIAL LEAD FROM TUNER.

COIL L3/L4 - WOUND WITH 30 SWG WIRE.



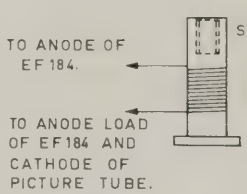
PINS 1&3 (PRIMARY WINDING)
PIN 3 - TO ANODE WITH 10K RESISTOR.
PINS 4&6 (SECONDARY WINDING)
PIN 4 - TO GRID.

COIL L5/L6 - WOUND WITH 30 SWG WIRE.

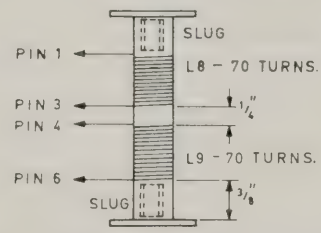


PIN 3 - TO ANODE.
PIN 4 - TO DIODE AND ONE END OF 10pF CAPACITOR.

COIL L7 - WOUND WITH 24 SWG ENAMELLED WIRE ON 0 B.A. SLUG TUNED FORMER (ALLADIN TYPE).



COIL L8/L9 - WOUND WITH 40 SWG, ENAMELLED OR POLY-VARNISH WIRE.



PIN 3 - TO ANODE OF EF 80 AND ONE END OF 15pF CAPACITOR.
PIN 4 - TO GRID OF EH 90 AND ONE END OF 10pF CAPACITOR.

COIL L10 - SAME AS L9 WINDING OF L8/L9

NOTE :- L1/L2, L3/L4, L5/L6, L8/L9 AND L10 ARE ALL WOUND ON 2" LONG FORMERS WITH 0 B.A. SLUGS AND MOUNTED IN 2" ALUMINIUM CANS.

The frame pulses are integrated in passing through the 2 stage 100K ohm and 500 pf. network and are fed via V14A, again half of a 12AU7A, operating this time as a true cathode follower, with grid bias, to the suppressor of the frame oscillator. The cathode follower is again included to prevent random frame pulses coming back through the circuits and causing random triggering of the line timebase oscillator.

We might pause at this juncture to consider the effects of integration of the frame pulses a little more closely.

THE EFFECTS OF POOR SYNCHRONISING

Some of the earlier designs of synchronising and oscillator circuits have suffered from a tendency to lose interlace, or exhibit frame jitter, which shows up as a vertical movement of the picture over a distance of several lines. To understand why this takes place we must quickly examine the way that the oscillators are synchronised. At normal "locked" settings of the vertical and horizontal "hold" controls the vertical and horizontal oscillators have a natural period of oscillation which is slightly longer than the standard line and frame intervals. Thus when there is no sync. signals present, the raster contains less than the normal 50 fields, and the total number of lines per second is somewhat less than 15,625. When the sync. signals are present, the sync. pulses trigger each oscillator slightly before the end of its natural forward stroke, thereby reducing the period of each cycle, and increasing the number of cycles per second to 50 and 15,625 respectively.

Two situations can arise to upset this normal state.

1. Any spurious signal reaching the oscillator before the regular sync. pulse can trigger the oscillator early so that it commences its retrace and therefore the following forward trace too soon. The part of the picture associated with this line or frame is therefore displaced in relation to the picture as a whole. It is for this reason we have used cathode follower isolaters with each oscillator.

2. If a sync. pulse is lost or obliterated by noise for any reason, the oscillator will not trigger until the end of the natural period. The retrace and following for-

continued on page 24

AWA Deep Image Tv. Receiver TX 31 Series

—continued on pages 20-22

SOCKET VOLTAGES

Code No.	Type	Function	Operating Conditions	Anode to Chassis Pin No.	Anode to Chassis Volts	Screen to Chassis Pin. No.	Screen to Chassis Volts	Cathode to Chassis Pin. No.	Cathode to Chassis Volts	Grid to Chassis Pin No.	Grid to Chassis Volts
V201	6BZ6	1st Video I.F.	30mV	5	120	6	120	2	0	1	-4
			No Signal	5	110	6	110	2	.5	1	-.2
V202	6EW6	2nd Video I.F.	30mV	5	260	6	260	2	130	1	127
			No Signal	5	245	6	245	2	120	1	120
V203	6CB6	3rd Video I.F.	30mV	5	230	6	140	2	1.5	1	0
			No Signal	5	225	6	135	2	1.5	1	0
V204A	6EB8	Video Amp.	30mV	9	130	8	150	6	2	7	-1
			No Signal	9	120	8	125	6	2	7	-.7
V204B	6EB8	Sync. Amp.	30mV	3	110	–	–	1	0	2	-1.5
			No Signal	3	105	–	–	1	0	2	-.3
V205	23CP4 AW59/90	Picture Tube	30mV	Side	16KV*	3	460	7	135	2	°75
			No Signal	Contact	16KV*	3	445	7	130	2	°70
V301	6BU8	Noise Gated AGC & Sync. Separator	30mV	3	-50	6	38	1	50	2	120
				3	-4	6	36	1	45	2	115
			No Signal	8	100	9	30	–	–	7	50
			30mV	8	90	9	37	–	–	7	45
			No Signal	5	255	–	–	6	0	4	-23
V302A	6EM7	Vertical Oscillator	30mV	5	260	–	–	6	0	4	-23
			No Signal	2	240	–	–	3	40	1	0
V302B	6EM7	Vertical Output	30mV								
			No Signal	2	235	–	–	3	48	1	0
V401	6AL5	Phase Discriminator	30mV								
				7	-16	–	–	1	0*	–	–
			No Signal	7	-14	–	–	1	0	–	–
			30mV	2	-16	–	–	1	0*	–	–
			No Signal	2	-14	–	–	5	0	–	–
V402	6CG7	Buffer Amp. Hor. Osc.	30mV	1	270	–	–	3	9.5	2	0*
			No Signal	1	260	–	–	3	10	2	-0.5
			30mV	6	185	–	*	8	0	7	-90
			No Signal	6	180	–	–	8	0	7	-88
V403	6DQ6-A	Hor. Output	30mV	Top Cap	4KV	4	170	8	12*	5	-24
			No Signal		4KV	4	165	8	12*	5	-23
V404	6AU4-GTA	Damper	30mV	5	270 pk.	–	–	3	3.1KV pk.	–	–
			No Signal	5	260	–	–	3	3.1KV pk.	–	–
V405	1B3-GT	H.V. Rect.	No Signal	Top Cap	16KV pk.	–	–	–	16KV*	–	–
			30mV	4, 6	285 A.C.	–	–	2, 8	280	–	–
V406	5AS4	Rectifier	No Signal 30mV No Signal	4, 6	285 A.C.	–	–	2, 8	275	–	–

Socket Voltages V323
V1 R.F. Amp.
V2 Converter R.F. Oscillator
Unable to be measured accurately

V101	6AU6	Sound I.F.	30mV	5	80	6	85	7	0.3	1	-4
			No Signal	5	60	6	60	7	0.35	1	-0.2
V102	6AL5	Ratio Detector	30mV	2	-6	–	–	1	6	–	–
			No Signal	2	-1.5*	–	–	1	1.5*	–	–
				7	0.5	–	–	5	1	–	–
				7	0.1	–	–	5	0.1	–	–
V103A	6EB8	Audio Amp.	30mV	3	130	–	–	1	1.5	2	0
			No Signal	3	125	–	–	1	1.5	2	0
V103B	6EB8	Audio Output	30mV	9	275	8	170	6	4	7	0
			No Signal	9	270	8	165	6	4	7	0

Resistance Measurements and Coil Connections

Windings	D.C. Resistance in Ohms
Tuner windings	*
L101 sound I.F.	1.2
L201 40.4mc/s trap	*
L202 video I.F. input	*
L203 I.F. filter choke	4
L204 I.F. filter choke	*
L205 video peaking coil	6
L206 5.5mc/s trap	1.5
L207 video peaking coil	5
L401 sinewave coil	55
L402 H.F. choke	*
L403 Horiz. linearity	7.7
L404 Deflection coil	6.5
L405 Deflection coil	6.5
L406 Deflection coil	9.3
L407 Deflection coil	9.3
L408 Filter choke	40
TR 101 Ratio Detector	
Pri. 1 - 6	9.5
Sec. 3 - 4	1
TR 102 sound output	
Pri. st. to tap	940
Tap to fin.	40
Sec.	*
TR 201 1st video I.F.	
Pri. 1 - 2	*
TR 203 3rd video I.F.	
Pri. 1 - 4	*
Sec. 2 - 3	*
TR 301 Vert. block. osc.	
Pri. Bu-Gr	450
Sec. Ye-Bk	130
TR 302 Vert. output	
Pri. Bu-Rd	370
Sec. Rd-Ye	2.5
TR 401 Horiz. block osc.	
Ye-anode	24
Ye-C407	88
TR 402 Horiz. output trans.	
1 - 8	3
2 - 3	1.8
3 - 4	3.2
4 - 7	6.5
7 - 6	4.2
6 - 5	5.2
5 - anode	390
TR 403 Horiz. width	
Pri. 1 - 4	5.5
Sec. 2 - 3	*
TR 404 Mains Transformer	
Pri. Wh-Bk	5.5
Sec. Red-Rd	40
TR 202 2nd video I.F.	
Pri.	*
Sec.	*
Trap	*

* Less than 1 ohm.

The above readings were taken on a standard chassis, but substitution of materials during manufacture may cause variations, and it should not be assumed that a component is faulty if a slightly different reading is obtained.

WAVEFORM VOLTAGES — COMPOSITE VIDEO WAVEFORMS SHOWN VARY WITH CONTRAST SETTING

BLACK VALUES MEASURED ON VOLTOHMYST (PEAK TO PEAK)

RED VALUES MEASURED FROM C R O. WITH LOW CAPACITANCE PROBE

ALL D.C. VOLTAGES IN RED MEASURED ON VOLTOHMYST WITH CONTROLS NORMAL AND NO SIGNAL INPUT

* VARIES WITH NOISE.

● DO NOT MEASURE

O VARIES WITH BRIGHTNESS

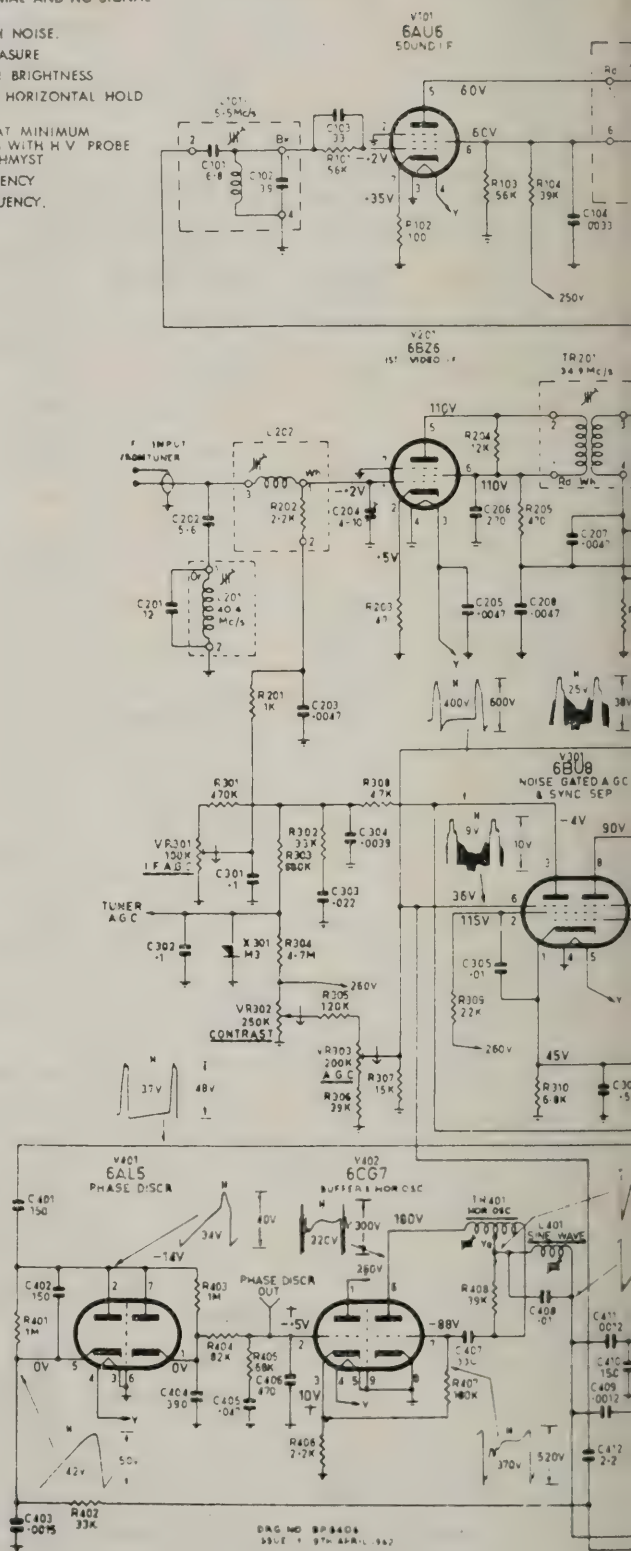
↕ VARIES WITH HORIZONTAL HOLD SETTING

□ MEASURED AT MINIMUM BRIGHTNESS WITH H.V. PROBE ON VOLTOHMYST

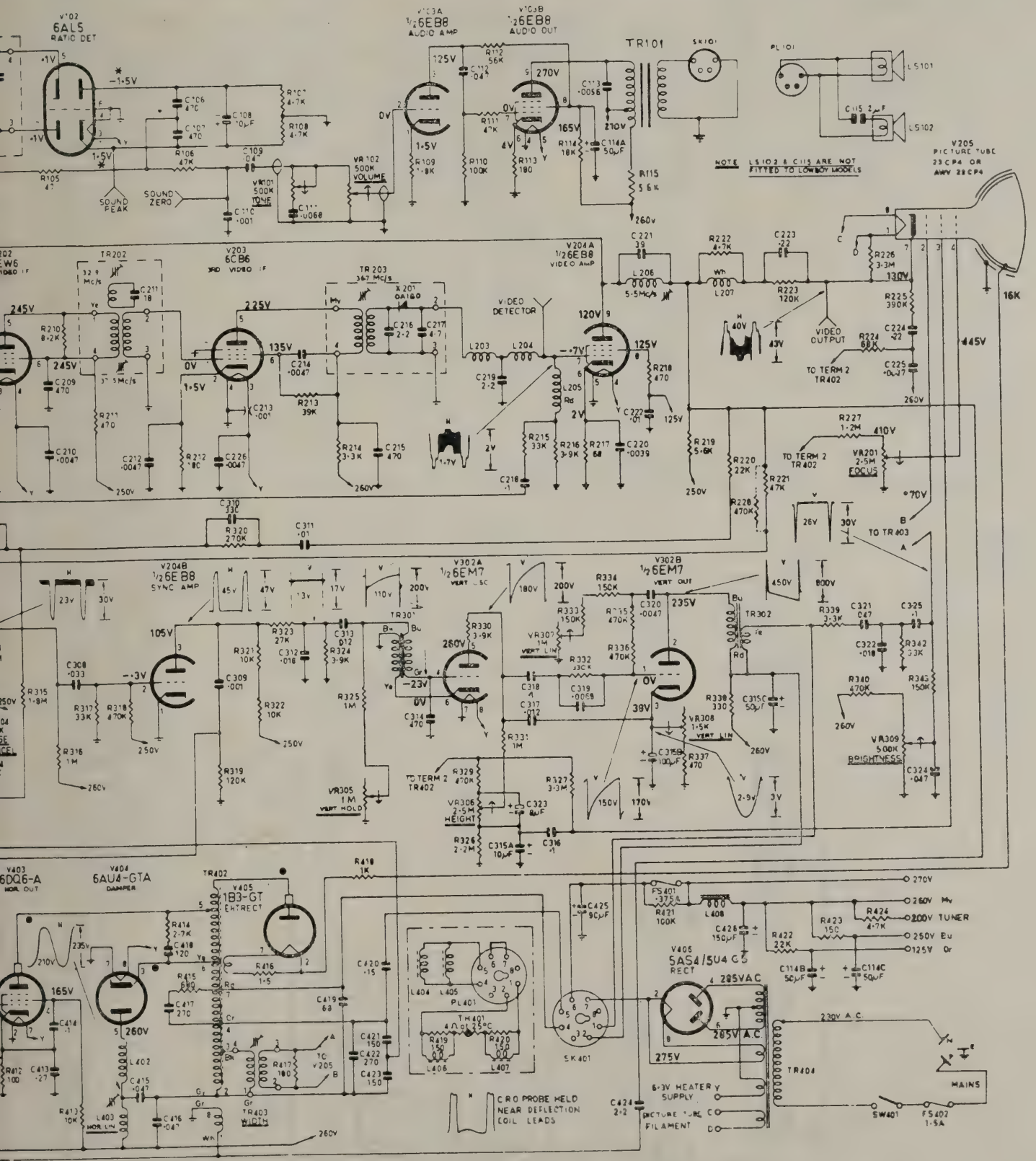
XL HOR. FREQUENCY

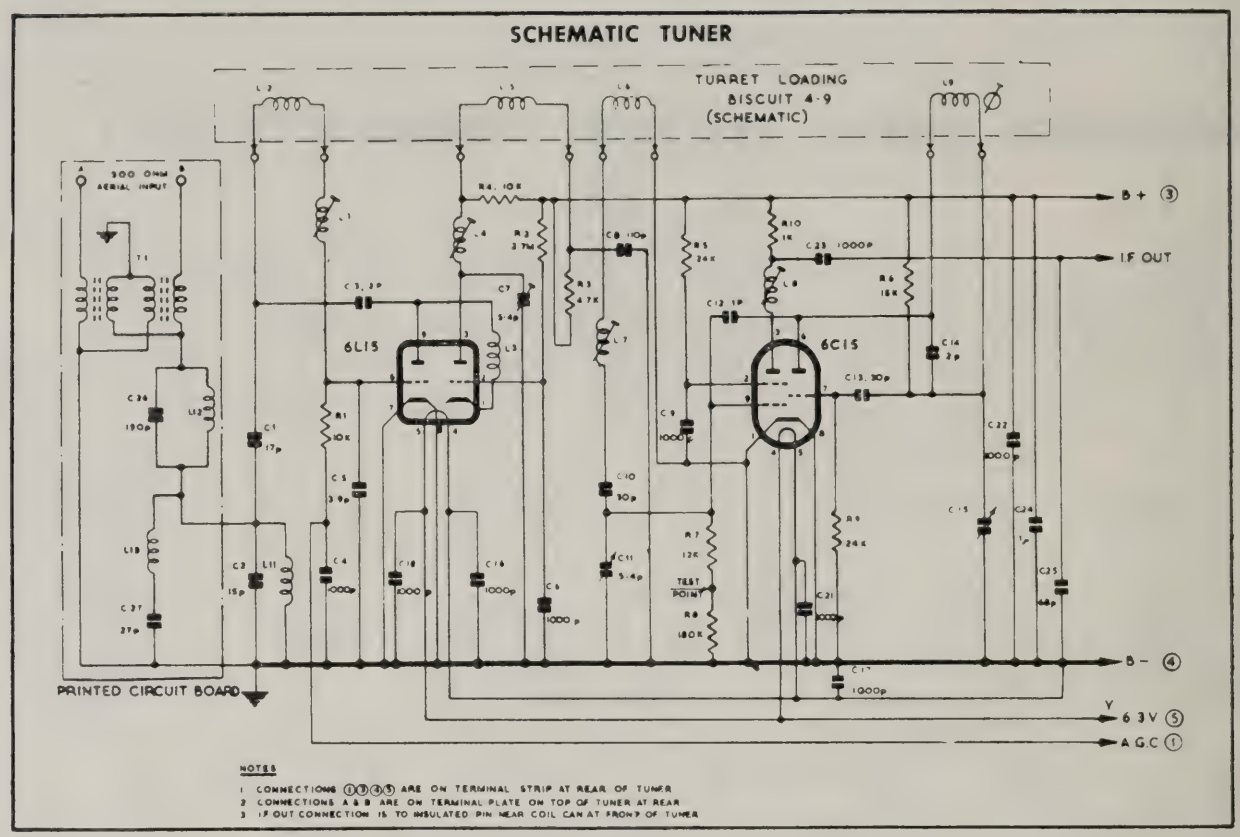
XV VERT. FREQUENCY.

CIRCUIT A.W.A

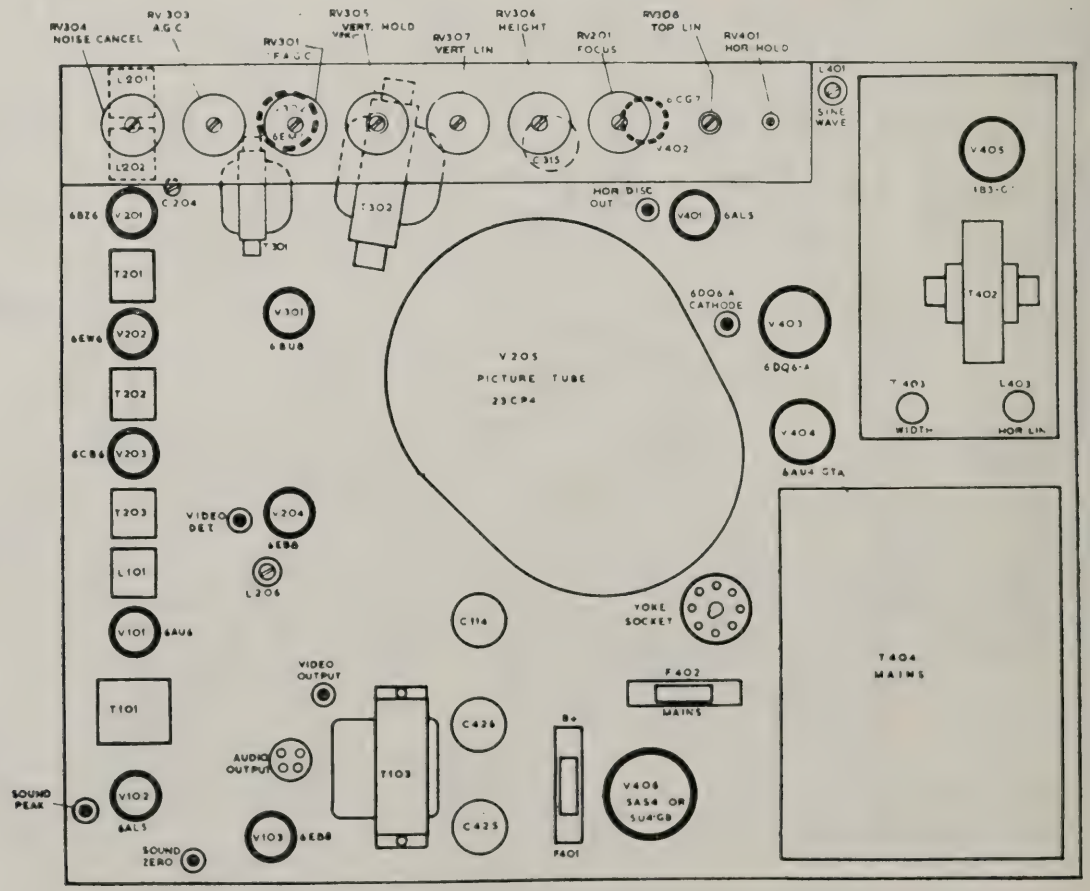


EVISION RECEIVER CHASSIS – TX31 SERIES – MODELS ZL272 · ZC272





CHASSIS LAYOUT



SERVICEMAN'S COLUMN

Conducted by J. Whitley Stokes

Every so often as a change from the inevitable "brought back" transistor radio somebody comes along with a brought back TV set. Just recently I had two examples of this, one being a German 19" model the other being a 19" English dual-standard model.

The English set belonged to a family who had arrived to settle in this country and the head of the house was by way of being an electrician who knew enough about TV to realize that different countries had different standards. He therefore made enquiries before leaving his homeland and discovered that N.Z. was on the 625 line standard. Being "in the trade," as he put it, he forthwith proceeded to a wholesale warehouse and asked for a 625 line TV set. Just like that! He got a 625 line model too—in fact he got more than that—he got a combined 405-625 line model known in Britain as a dual-standard model. And thereby hangs a tale.

As soon as he was settled in his new home our electrician lost no time in unpacking his TV set and hooking up a makeshift aerial. However apart from some hiss from the speaker and a few speckles on the screen he was unable to receive anything. He was more annoyed than concerned, however, and formed the not unreasonable opinion that something must have come displaced during the voyage. It was at this stage that I had been called in.

For the benefit of anyone who may not be **au fait** with the present TV position in Britain it should be mentioned that in addition to the well known British 405 system of transmission there is also a modified 625 system in the UHF band. One of the main differences between this latter system and the 625 line C.C.I.R. system is that the British system retains the positive modulation which has always been used on 405 lines. In practice dual-standard receivers are fitted with two separate tuners, one VHF one UHF, and provided with a switching system which in addition to changing from one tuner to the other simultaneously alters certain features in the video and sound I.F. sections.

Lest it be thought that it was simply a matter of reversing the tuner positions so that the VHF tuner was connected when the set was switched to "625" I might add that there was rather more to it than that. So much so that the owner did not feel inclined to spend money on alterations and as he happened to have a friend returning to England decided to re-pack the set and send it back. He thought that it would be possible to exchange it for a 625 line **export** model and I agreed that if this were possible it certainly would be the best thing to do.

The second case concerns a German 19" "portable" model which had been brought in from Hong Kong by a returning traveller. Although classed as a portable, being provided with a handle, the darn thing was so heavy, due partly to the two large capacity batteries fitted, that it took two hands to lift it. The owner admitted that it had caused him one or two anxious moments getting it back home as with two hands needed to hold his portable he couldn't manage any other baggage at the same time. However, it was eventually landed safely and duly installed aboard the owner's Fairmile launch which, I was informed, was equipped with no less than three different electric supplies, namely 12v DC, 110v DC and 230v AC (some launch!). The TV set had been used for only a short period, on its own 12 volt battery, when it had suddenly ceased to function. The owner had forthwith committed the unspeakable crime known to servicemen as "having a go at it himself". Why it is that this type of owner imagines that by twiddling every pre-set control (and this model had plenty) and even I.F. slugs, he will restore a dead set to life I'll never know. Eventually he gave it up as a bad job and this is where I came in.

My first introduction to the job was when the owner rang up and told me his new set had stopped suddenly and what did I think was the matter. I guessed a fuse had blown and as it turned out this was correct but there was more to it than that as I was to discover later. The owner stated he had been unable to find any fuse so arranged to bring the set in for a check-up. It turned out to be a rather elaborate model containing, if I remember rightly, 34 transistors, 17 diodes and a DY 80 EHT rectifier. Although of German manufacture it could hardly be classed as all German as the picture tube was American Westinghouse and it contained Motorola and Bendix transistors in the line output section. The whole thing operated from a 12 volt supply which was provided by either the self-contained battery or a transformer and bridge rectifier. A switch on the back was used to select the type of operation and in addition was provided with a third position on which the batteries could be charged from a built-in battery charger. In addition to TV on UHF and VHF channels there was an FM radio receiver.

The owner simply stated that he had been unable to find a fuse anywhere and at first so was I. Eventually I discovered a fuse tucked away inside the battery charger which was arranged as a plug-in unit although integral with the rest of the set. However, as soon as the fuse was replaced it blew again so this looked like a clue but it didn't explain why the set wouldn't work on the 220v position either though. To cut a long story short, after longer than I care to admit I discovered a broken connection to one of the lugs of the battery-mains change over switch. When this had been resoldered the set

continued on page 37

R. E. & C. 6" Tv. Set

continued from page 18

ward scan therefore occur too late and the relevant picture information is once again displaced.

Very slight irregularity of the frame oscillator and consequent displacement of information is evident as a lack of, or, variation in interlace. More serious irregularity can cause frame jitter.

These effects can be evident in frame synchronising circuits in many Tv. receiving designs but are not so noticeable in line oscillators because most of these are of the "flywheel sync." type. It is important however in this case because the time oscillator is directly triggered by the sync. pulse.

IMPROVED FRAME PULSE SHAPING

Returning now to the frame synchronising circuits and the integration circuit we have found that from a simple integrator such as we show in the main circuit the pulse builds up quite slowly over a period equal to several lines. There is some variation, therefore as to the exact point at which the frame oscillator triggers. Under these conditions slight extra voltage due to stray line sync. pulses may influence the exact triggering point. It is for this reason that we have included details of a rather different frame sync. circuit associated with V14A. This does not use the conventional integration method but a method of time constant selection and pulse differentiation to produce a such sharper synchronising pulse. The 220 pf. and 100K resistor in the grid circuit of V14A have a time constant of about 22 miro-secs. and the frame pulses are partially differentiated to produce a positive going spike pulse. When no sync. signals are applied, V14A is cut off by the bias at the cathode determined by the 68K and 10K resistors. When sync. pulses are applied, the positive going spikes cause the tube to conduct for a short period each frame pulse. Only the first frame pulse is effective however. This causes a large negative going pulse to be produced at the anode of the tube which is applied via the 500 pf. to the suppressor of the frame oscillator. This locking is very effective and the frame hold control can be varied over quite wide limits before the locking action slips.

COMPONENT AND WIRING LAYOUT

One final point which also becomes evident from this discussion is that during layout and construction of this part of the receiver, the frame and line sections should be physically, well separated, so that stray energy from one section does not become coupled into the other. It generally seems that the best layout is to place the sync. separator, line and frame oscillators and amplifiers on one deep chassis together with the picture tube, shift controls and voltage divider net work for the various elements of the C.R. tube. The sync. separator and cathode-follower-clipper for the line timebase can be located on one side of the C.R.T. near the front followed in order towards the rear by the line oscillator tube and amplifier.

The frame sync. pulses can be mounted to the opposite side of the chassis and the frame deflection section can follow a similar pattern towards the rear. The hold controls, height and width controls can be mounted through the chassis in their logical places as they rarely need adjustment. So too can the shift controls be located alongside the main H.T. bleeder chain which should be assembled on an insulating panel running from front to rear on top of the chassis underneath the stem of the picture tube. This general layout brings all the main connections to the base of the picture tube at the rear — the most suitable place. CAUTION: One point which must be kept in mind is that the shift controls can have nearly the full H.T. voltage across them, to earth and therefore they must be mounted on insulating panels and insulated extension shafts used between the shafts of the potentiometers and the knobs.

Under the chassis, separating the two main oscillator-amplifier chains there should be a second insulated panel extending from front to rear. On this is mounted all the H.T. power components such as decoupling resistors and electrolytic condensers. The only control which needs to be located on the front panel is the brilliance control which is at a relatively low potential part of the H.T. network.

THE LINE AND FRAME OSCILLATORS

As mentioned previously in this article, both oscillators are of the "Miller Integrator Transitron" type. In addition to the usual high transconductance pentode there is a triode employed as a cathode follower.

This type of oscillator is characterised by excellent linearity on the forward part of the scan, and when a cathode follower is utilised, the oscillator also provides a very fast retrace. To enable constructors to understand the operation of this oscillator we shall devote a little space to attempting to describe the various "changes of state" involved in its operation.

The term "transitron" occurs in the title because the circuit makes use of the transitron or negative resistance effect between the suppressor and screen of a pentode valve. For the purpose of this discussion mentally neglect the cathode follower tube and connect the capacity to the pentode anode.

First, consider the condition at some instant during the cycle of operations when the anode current is cut off or reduced to zero. No current flows through the anode load resistor and because there is little voltage drop across this resistor, the valve anode and one side of the capacitance connected to it are at full H.T. The other side of this anode-grid capacitance is at a potential very close to earth due to the effect of the diode action between grid and cathode. Under these conditions the capacitor changes to nearly the full H.T. voltage. However this condition cannot prevail because the valve under these conditions must pass current. As soon as anode current passes there is a voltage drop created across the plate load resistance, and the anode voltage shifts negatively towards earth potential. This

shift is also coupled to the grid leaving it negative with respect to earth. The grid potential falls abruptly to a point approaching cut-off condition, after which further changes occur more slowly. However with the grid negative there is no grid-cathode conduction and the only way the grid cathode capacitor can discharge is via the grid resistance. This it proceeds to do immediately the grid swings negative. As discharge continues, the grid gradually moves more positively towards zero bias.

This positive going change in grid voltage tends to make the tube draw more current and the plate voltage drops even further, but any change is coupled to the grid through the coupling capacitor and this tends to oppose the grid moving positive.

Thus the rate at which the plate potential can change is dependant on the capacitance of the grid-anode capacitance, the grid "leak" resistance and the valve itself. The valve's effect is quite marked, as it alters the natural R-C discharge curve to make it substantially a straight line. This gradual linear discharge period and the dependant shift in anode potential is commonly referred to as the "rundown" period providing the forward scanning trace on the oscilloscope screen. Now we come to the retrace condition.

During rundown, the screen potential of the tube does not undergo any important changes. However when the anode potential falls to something close to or even less than the screen voltage, the screen current increases sharply resulting in a sudden drop of screen voltage. This is coupled to the suppressor via the screen-suppressor coupling capacity and the suppressor is therefore driven negative also, further increasing the screen current by cutting off some of the anode current. The effect is cumulative and rapid, and quite suddenly the anode current is cut off. This condition persists for a brief interval, and in this interval the anode-grid coupling capacity has a chance to change once more. Once the bias on the suppressor leaks away then the cycle repeats itself.

The time constant of the screen-suppressor circuit is chosen with respect to the desired working frequency.

Up to this point we have not discussed the inclusion of the cathode follower. The anode of the pentode is coupled directly to the grid of the triode which has a load resistance in the cathode circuit. By cathode follower action, the cathode at all times assumes a potential close to its grid and therefore also close to the EF80 anode.

The important difference now however is that the capacitance between anode and grid of the pentode (via grid-cathode of the cathode follow) is changed not through the anode load resistance but via the low impedance of the cathode follower valve during the recovery or fly-back period. This means that the fly-back can be very short.

In the case of the line oscillator the anode capacitance is relatively small but the fly-back time is very short. In the case of the frame oscillator, the fly-back time can be longer, but the capacitance is so much bigger thus demanding more charging current in the same period. Thus the cathode follower is useful in both cases.

THE DEFLECTION AMPLIFIERS

With the high voltage available at the anodes of both amplifiers, the 12AU7'A have no trouble in producing adequate voltage to more than overscan the picture tube However most electrostatic deflection tubes have one set of deflecting plates closer to the cathode than the other, these will be the most sensitive elements and therefore it is advisable to use them for the line deflection which requires maximum scan. The frame scan is somewhat less than the line scan. This is ¾ of the line scan as is called the aspect ratio.

Each amplifier consists of a cathode-coupled type phase inverter and amplifier, thus providing symmetrical deflection from the output of the oscillator. The amplitude of input voltage is controlled by the height and width controls which are the potentiometers in the cathode circuits of the oscillator cathode-followers.

THE DEFLECTION COUPLING CAPACITANCES

As there is a D.C. potential of 2000 volts on the deflecting plates the breakdown voltage of the coupling capacitors should be at least this value. There must be many .25 mfd. or similar can type 2000v. papers scattered amongst older experimenters, as war surplus. However for many of our readers these are not available. There are a number of makers who produce capacitors up to .5 mfd. 1000v. D.C. test. One type which is suitable is the Philips C1O1CD/A390K. Two of these in series in each anode of the frame circuit would be quite suitable. Smaller capacitances can be used but it is advisable not to drop below 0.1 mfd. total on each side if waveform distortion is to be avoided. For the line oscillator total capacitance value as small as 0.01 on each anode is quite suitable. There are a number of makes of high voltage ceramics for TV. use in capacitances up to .005 mfd. Two of these could be connected in parallel for each coupling quite satisfactorily. The author tried out using 5 of the .5 mfd. 400v. Polyester capacitors in series for the frame capacitance. Although this may appear to be somewhat bulky, these capacitors are relatively inexpensive and can be mounted on a panel. As far as the line amplifier coupling is concerned capacitances of the order of .01mfd. on each anode are quite satisfactory. There are a number of high voltage disc ceramics in capacitances up to .005 mfd. available. Designed for TV. use, two of these .005 mfd. in parallel in each plate circuit would serve admirably. The main point to keep in mind is that any capacitance used here must have no leakage or intermittent breakdown condition, otherwise it will be impossible to keep the picture correctly centred on the tube face.

This concludes the discussion of this part of the circuit. Next month we will give circuit details of the picture tube, voltage divider and controls, the EHT. circuit and we will discuss the alignment of the I.F. strip.

British Invention Reads Data Directly Into Computer . . .

by S. Handel, A.M.I.E.E.

During the past decade there have been many remarkable improvements in the speed, power and efficiency of electronic computers. Almost every category of components used in the construction of computers—memory and storage devices, arithmetic and fast switching circuits, control circuits, high-speed output printing devices, and so on—has demonstrated the progress that has been made; and the power of digital computers has increased a hundred fold during the period. The single significant exception to this general advance is in the techniques of data preparation, which now represent the major impediment to the full flow of data that the computer is capable of processing.

For the most part, the methods of data preparation now in use —even for the most advanced designs of computer—are substantially the same as those used for early computers. Although there has been continuous development of punched tape, punched card, and magnetic-tape input systems, they are still relatively cumbersome and slow compared with the other parts of the computer system. Attempts have been made, in both the United States of America and Europe, to perfect devices that will be able to read data directly

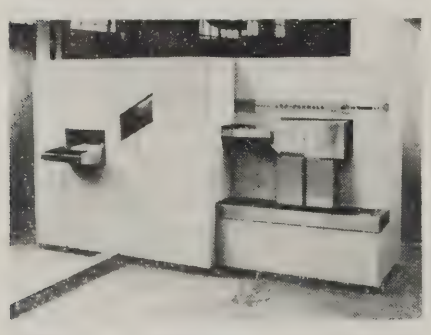


Figure 1 — General view of an Autolector installation.

into a computer with a speed and efficiency to match the other elements of the system, but until now none of these has proved entirely satisfactory.

Against this background the successful completion of a British invention for data preparation which reads directly into a computer is of particular interest.

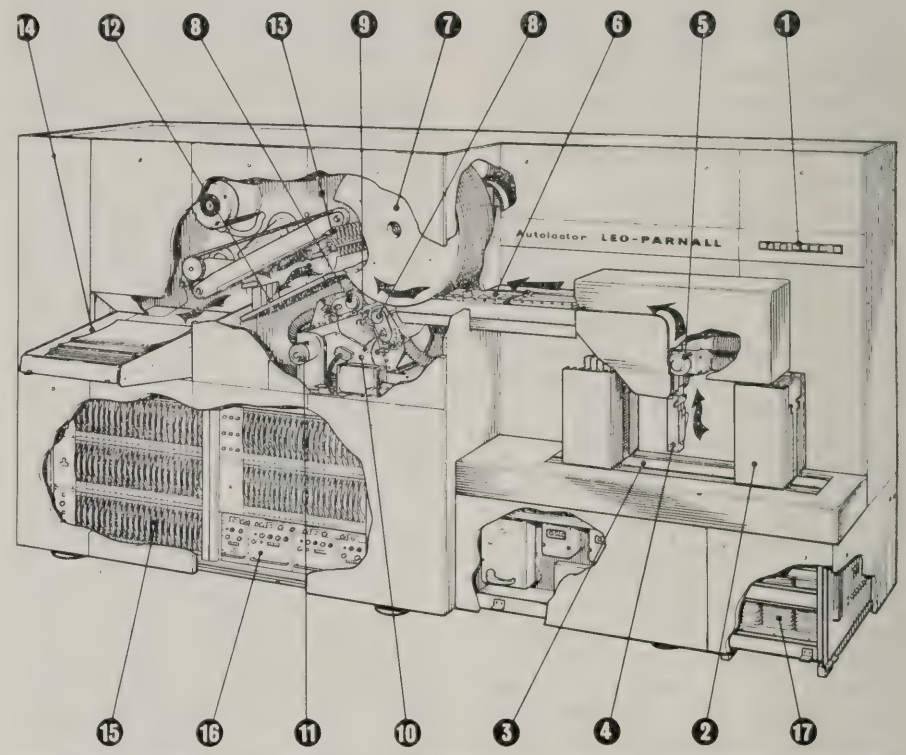


Figure 2 — Mode of operation of the Autolector: (1) Control panel; (2) Loaded cassette; (3) Conveyor belt; (4) Selector arm; (5) Counter-rotating double-feed preventer; (6) Alignment rollers; (7) Vacuum drum; (8) Tungsten-iodine lamps; (9) Lens; (10) Optics box; (11) Document margin scale adjustment; (12) Reject bin; (13) Selector knives; (14) Output hopper with vibrating platform; (15) Assembler logic; (16) Power packs—1; (17) Power packs—2.

Most Practical Solution

The new invention, named "Autolector", is an on-line equipment based on an automatic, optical document reader that is claimed to be the most practical solution yet found to this difficult problem. It not only eliminates the need to transcribe data from data forms into cards or paper tape, but also makes considerable reductions in the time required to get the data into a computer after it is received. Using Autolector, the information can be taken direct from the document on which it was originally recorded and fed straight into the computer store, at the rate of 14,000 items per hour.

Autolector was developed entirely in Britain by English Electric-Leo Computers Ltd. in co-operation with Parnall and Sons Ltd. It was originally intended for the LEO III family of computers, and owes much in concept to the English Electric-Leo Lector, a hand-fed off-line document reader. The Lector was first introduced in 1962 and established the foundations of the new method of data collecting and processing. More than 40 Lector input devices have been sold throughout the world.

Experience acquired in the design, manufacture, and use of the Lector is embodied in the much more advanced Autolector, an automatic optical scanning device which reads computer printed, embossed plate marked or handwritten forms directly into the computer. It is coupled on line and is controlled directly

continued on page 33

Extended Range V.H.F.

*G. C. RIDER, B.Sc.

Although efforts to extend the range of v.h.f. communications are largely concentrated on aeromobile applications, the subject is of interest to engineers concerned with point-to-point communication systems because their responsibilities often include ground equipment for air traffic control. Extended range v.h.f. may imply diffraction as well as scatter, and satisfactory prediction formulae take account of both modes of propagation. The essential requirement for extended ranges is improved system gain, provided by higher transmitter power and higher gain aerials at the ground stations. Although these may prove too expensive to allow the technique to be widely adopted, its usefulness has already been proved in a number of experiments.

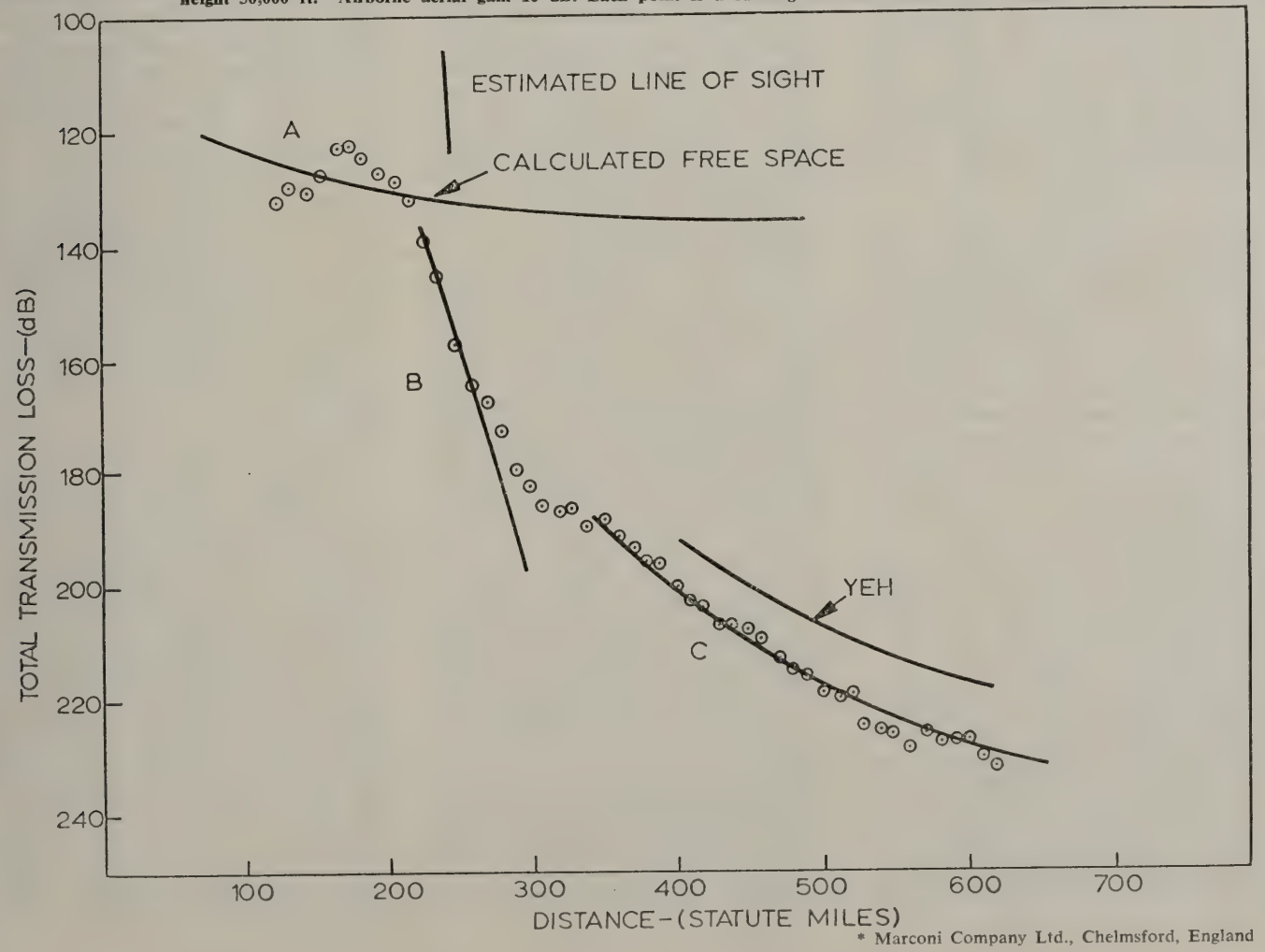
1. Extended Range

Fig. 1 shows a field strength versus distance curve of the signal received by an aircraft as it flies out over the Atlantic.[1] The test on which these curves are based is quite an arbitrary choice as curves of similar form have been given by many workers.

Three portions of the curve may be distinguished. Region (a) lies within the radio horizon where free-space levels at short range are reduced by interference effects due to ground reflection as the horizon is approached. Region (b) is the classical diffraction region in which the signal falls rapidly with increasing distance until region (c) is reached when the signal level is about 40 to 50 dB below the free space level. In region (c) a number of components scattered or reflected from atmospheric discontinuities combine in random phase to give the resultant signal, the diffraction signal having become small by comparison at these ranges. A characteristic of this region is a much reduced rate of attenuation with distance, about 0.17 dB per nautical mile, relative to free space.

In the conventional approach to v.h.f. communication only regions (a) and (b) are of interest, and since in (b) a large increase in system gain is required for a small improvement in range, v.h.f. systems are usually designed to operate almost entirely in the region (a). However, once a substantial increase in system gain can be achieved, the working threshold may be placed in region (b) and further range increases, extending into region (c), are then obtainable commensurate

FIG. 1 — Field strength versus distance curve for aircraft flying over North Atlantic. Frequency 220 Mc/s. Ground aerial height 80 ft. Aircraft height 30,000 ft. Airborne aerial gain 10 dB. Each point is a running 20 mile median of five flights.



* Marconi Company Ltd., Chelmsford, England

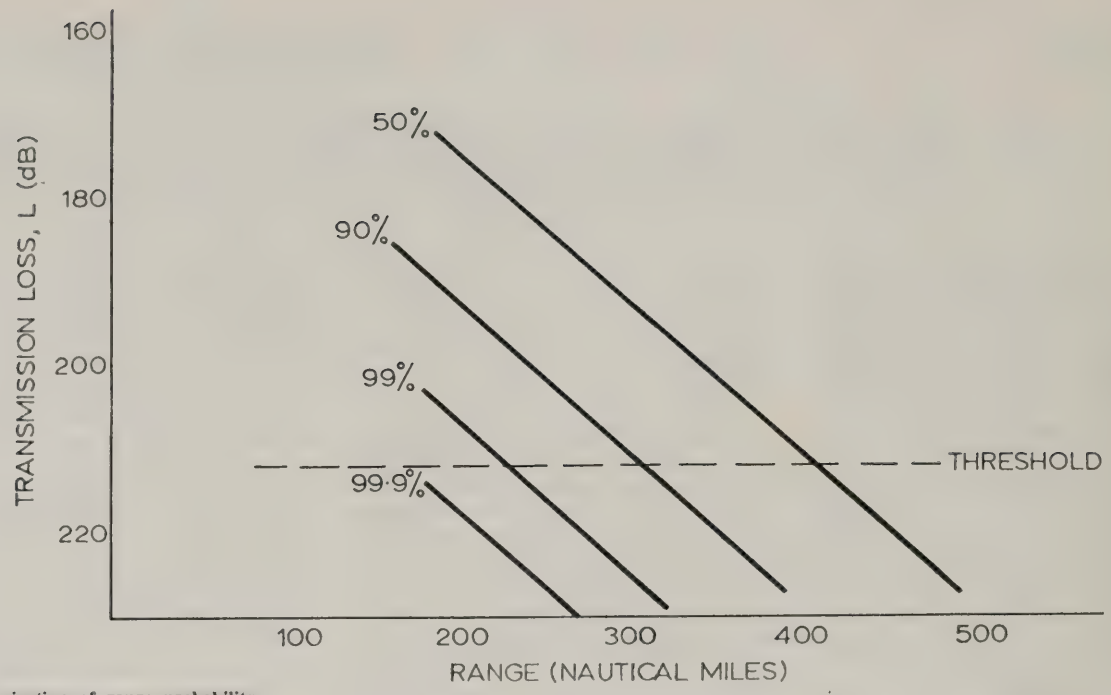


FIG. 2 — Derivation of range probability.

with the small slope of that part of the curve. The basic principle of extended range v.h.f. is thus to provide a large enough system gain to work on the "scatter" portion of the field strength versus distance curve.

This may well be called a "brute force" method, but not "brute force and ignorance," because the use of high gain aerials and high power transmitters produces much longer ranges than the ignorant would suppose.

2. V.H.F.

The foregoing comments would of course apply equally well to any system operating in the v.h.f., u.h.f. or still higher frequency bands, and doubtless similar scatter propagation phenomena also take place at lower frequencies but produce signals small and irrelevant by comparison with those transmitted by ionospheric reflection.

Point-to-point applications of the tropospheric scatter principle have usually employed frequencies in the u.h.f. band, the high gain aerials achievable in this band being an important consideration, and frequencies around 800-1000 Mc/s are found to be optimum after consideration of the many factors involved.[2]

It is, in general, for aeromobile operation that this method of extending range is applied in the v.h.f. band, and that for the good reason that these frequencies are already in use, with airborne equipment already in operation, both for communication and for navigation. Being intended for use in terminal areas, or at least within the radio horizon, the users have become accustomed to high reliability "one shot" communication on v.h.f. This they contrast with the conditions on h.f. which they must operate on long oceanic routes such as the Atlantic crossing. Sheer congestion of the h.f. spectrum and poor signal/noise often makes this system of communication time consuming. It is for these reasons that messages are not exchanged directly between pilot and air traffic controller, but are handled by a communications centre. Both pilots and controllers would much prefer direct speech contact. The interest of aircraft operators in extending v.h.f. ranges is therefore very clear.

3. What Has Been Done

3.1 Propagation Tests

A number of flight tests of extended range v.h.f. have been made under conditions varying from those of a propagation experiment to actual operation on airways. Ames,[1] to whom the data of Fig. 1 are due, carried out tests at 220 Mc/s over the North Atlantic. The system gain necessary for the long ranges recorded was obtained in part by the use of a directional airborne aerial, this being the most economical method at his disposal. However, effective aerial gain is not yet obtainable on an operational aircraft and, as later sections indicate, the necessary system gain is obtained from very large ground based aerials and good receivers, with high power transmitters on the ground to give equal system gain in the ground-to-air direction.

Ames's experiments are of interest since they were conducted in a well mixed atmosphere, and his observations may be used as a test of prediction methods. Moreover he made simultaneous observations using two aircraft at different heights, and thus predictions of height gain may also be tested.

3.2 Prediction Formulae

A method for the computation of extended range v.h.f. is required. Methods are available covering the complete gamut from pure scatter theory to pure empiricism, and which take account in more or less detail of the numerous parameters which may be considered. The expression due to Yeh,[3] given in Appendix I, has the twin merits of simplicity and acceptable accuracy.

In Fig. 1 Ames's data is compared with Yeh's prediction and the consistence between them

indicates the extent to which the expected field strength may be calculated.

3.3 Airways Tests

The experiment of installing a high performance ground installation (capable, in terms of Fig. 1, of pushing the threshold into region (c)) for airways flying has been made at several locations. Under operational conditions it is impracticable to produce curves of field versus distance; it is more useful, too, if range probability curves are made from which can be seen the probability of establishing satisfactory communication as a function of range. The prediction formula may easily be made to give answers in this form. If the statistical distribution of the variation of median signal with time is known, then the probability of the signal exceeding the receiver threshold may be obtained as a function of range. Fig. 2 will clarify this. It has been drawn for a standard deviation of 7 dB, assuming a normal distribution of L in dB.

Fig. 3 shows the results of tests made from San Francisco over the Pacific air routes and reported by Vergara and others.[4] For a considerable fraction of the time (i.e., proportion of the test flights) very long ranges were obtained, attributed to duct-formation and elevated reflecting layers, and the prediction based upon the formula given above bears no relationship to these observations. However the smaller ranges, exceeded for 90% or more of flights, agrees quite well with Yeh's prediction, confirming the conclusion reached in Appendix I that if a high reliability is required the scatter signal must provide the basis on which the system is designed.

An amateur radio enthusiast on v.h.f. might rightly consider ten evenings of failure well spent if the eleventh gave him a range of 1000 miles, but this cannot be the outlook of the airline operator, for whom a high probability of success is vital. Certainly no probability less than 90% is to be considered for operational use.

In a well mixed atmosphere such as over the North Atlantic Yeh's prediction may be successful over a much wider range of probabilities. Fig. 4 shows the results of tests from Shannon, in Ireland, made by Pan American Airways Inc. Table 1 lists the equipment parameters in this test and this is used as a system reference in Fig. 5 in which the effect of the variation of system gain on reliable service range is shown.

4. What Can Be Done

Attention will be confined in this section to techniques and proposals strictly within the "state of the art," and no changes will be postulated in airborne equipment. The range to be obtained now depends very largely upon the size of ground aerial for which finance is available. In the Pan American Airways tests at Shannon already described, an aerial of 18 dB gain was used with a 1kW transmitter, and there are a number of routes for which an installation of this scale would provide a useful improvement in service.

It is also of interest to push the possibilities nearer to their limit, and a ground aerial of 33 dB gain as suggested by the Federal Aviation Agency may be considered. A nominal aerial aperture of the order of 40 x 40 metres is implied, and the actual array is thought of as a number of vertical stacks of yagi aerials. The beamwidth of such an array would be 4° x 4° and this is much too small in the horizontal plane to be of use. However, by adjusting the relative phase between stacks, the aerial beams may be steered over a large arc, say 60° or more, and this total arc may be monitored on "receive" by providing a separate receiver, with its own aerial phasing network, for each 4° beamwidth. In the "transmit" case beam steering is also envisaged; the receiver in operation would indicate the pointing direction required. It would probably be most satisfactory to employ a separate power amplifier for each stack so that phasing could be carried out at low power levels.

A ground receiver noise figure of 6 dB is assumed. This at first sight may appear unenterprising, but the sky noise is found to give an average background level such that an improvement of 4 dB in noise figure will improve the signal/noise by only 2 dB. The proposal is thus merely to increase by 15 dB the aerial gain, and thus the system gain of Table 1, giving a 90% probable range of about 400 nautical miles, more or less according to the ground station altitude (Fig. 5).

A typical airborne v.h.f. receiver may have an effective noise figure of 21 dB (lower figures providing no advantage because of man-made radio noise in the aircraft). The ground-to-air path thus has $21 - 6 = 15$ dB to be made up by ground transmitter power, so that a transmitter power of 800 watts is required. A larger power is desirable, say 2.5 kW, as this would make the aerial beam pointing accuracy less critical.

For air traffic control the usefulness of system range may not always be merely proportional to the range. For example, aircraft are required to report on each 10° line of longitude on the transatlantic route. Taking this and other factors, such as the actual preferred courses, into account it is estimated that about 70% of aircraft calls on this route could be handled on v.h.f. with suitably sited ground stations of the type just described. No changes would be needed to aircraft v.h.f. installations.

5. What Might Be Done

Various tentative systems proposals have suggested the possibility of an airborne v.h.f. aerial with significant gain, and the airborne transmitter power can also be boosted beyond 25 watts without running into insuperable difficulty. Aerial gains of 12 dB and transmitter powers of 250 watts have been mentioned as targets for forward thinking. The 20 dB so obtained would raise the 90% range to 550 miles. If a data link system is considered, using narrower effective noise bandwidth and transmitting data in bursts on the peaks of the fading, still greater ranges could be achieved, perhaps around 700 miles.

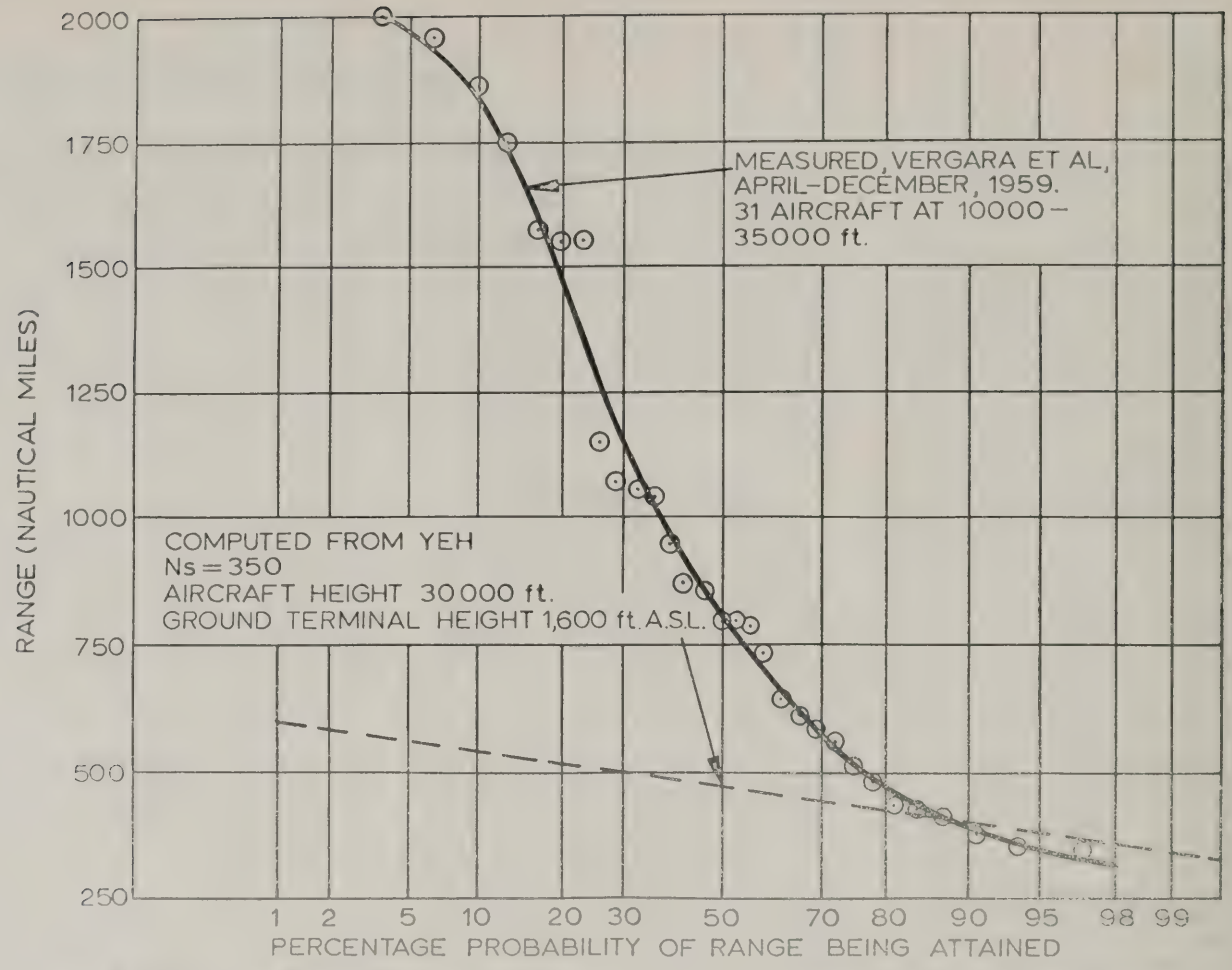


FIG. 3 — San Francisco Statistics, Pacific Route

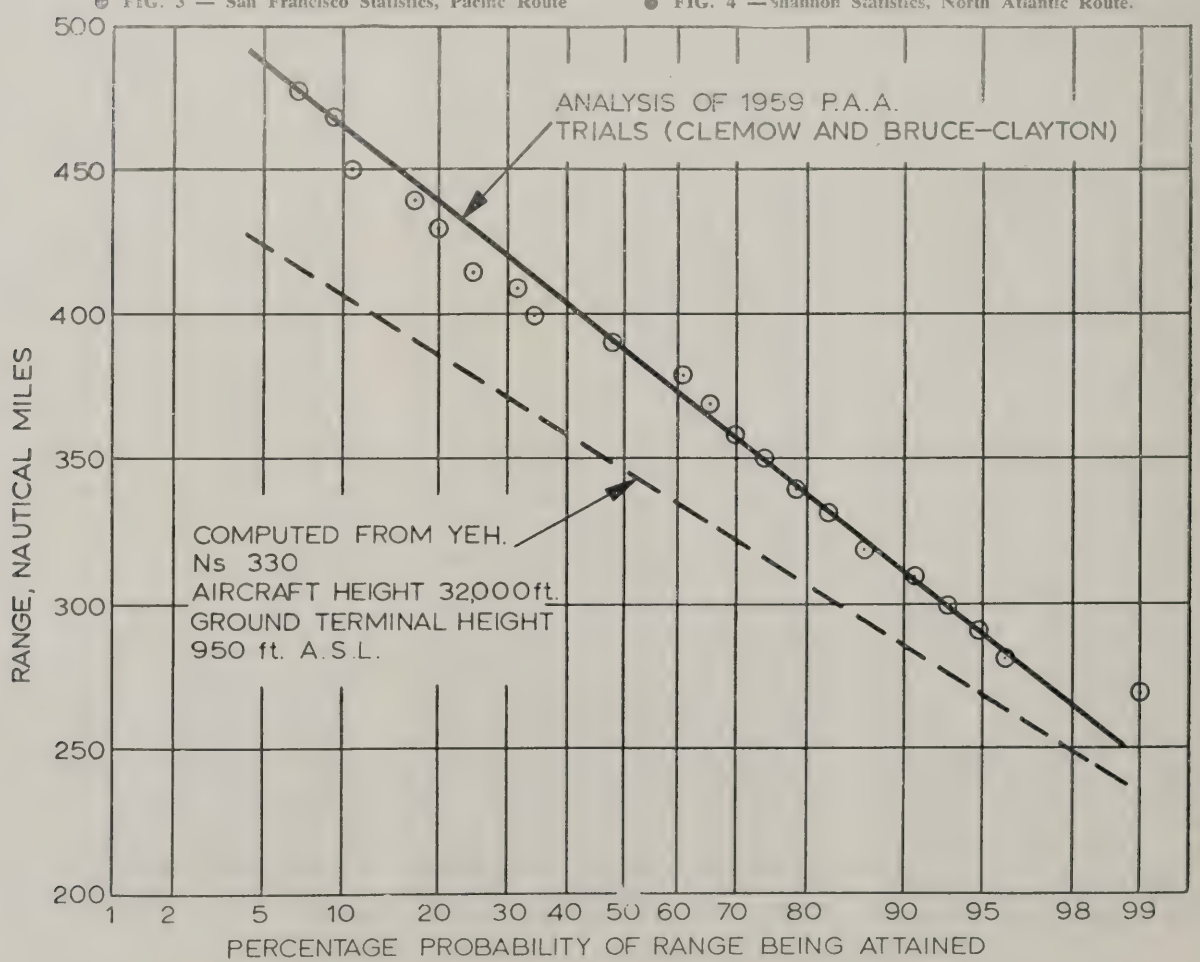


FIG. 4 — Shannon Statistics, North Atlantic Route.

However, all the ranges quoted are for communication with aircraft at operational heights. H.F. is still needed in case of distress, when aircraft have to descend to lower altitudes and, therefore, it seems that no system at present envisaged will enable Oceanic Air Traffic Control (e.g., the North Atlantic) to be conducted exclusively on v.h.f.

But there are many other airways, and the tests made by International Aeradio Ltd., from Bahrein,[5] have certainly convinced them of the welcome that awaits the extension of v.h.f. service ranges.

6. Conclusions

By using techniques within the current "state of the art," aeromobile v.h.f. ranges could be extended to about 400 nautical miles. This would require no change to airborne v.h.f. equipment already in use but it would necessitate an expensive steerable ground aerial which would probably have to be pointed by the controller. Nevertheless, such a system might be economic and it would provide a far better service than h.f., as well as reducing the congestion in the h.f. band.

No fundamentally new techniques are involved, either in equipment design or in modes of propagation. The truth of this will be clear to those who are able to re-read Isted's account[6] of the work of G. Marconi between 1928 and 1936, when he conducted a series of over-the-horizon tests on 600 Mc/s in the Mediterranean region. What was then a scientific experiment, and far in advance of its time, is now an engineering proposition of proven usefulness.

APPENDIX I

Yeh's Prediction Formula

Yeh gives the median path loss exceeded for 50% of a year as

$L = 30 \log f + 20 \log d + 10\phi - 0.2 (Ns - 310) + 57$ dB where f = frequency in Mc/s.

d = transmitter-receiver distance in statute miles,

ϕ = scatter angle in degrees, and Ns = mean surface value of the atmospheric refractive index in N units.

Whilst no attempt will be made to derive or justify this formula, a few comments will not be out of place. First we note that the free space path loss, LFS, is given by

$LFS = 20 \log f + 20 \log d + 37$ dB

so that the loss relative to free space (sometimes termed "scatter loss") is given by

$L - LFS = .10 \log f + 10\phi - 0.2 (Ns - 310) + 20$ dB.

The scatter angle, ϕ, may be defined by reference to Fig. 6. This single useful parameter takes some account of relevant ground features and obstructions as well as path length. For average paths and standard refraction we may use $\phi = 1°$ per 100 miles as a rough guide.

The refractive conditions of the path, depending, of course, on weather, climate, etc., are taken into account by the term $-0.2 (Ns - 310)$. It is customary for convenience to work in N units, where $N = 10^6 (n-1)$, n being the actual refractive index of the atmosphere and having a typical value at the earth's surface of 1.00031 for which N = 310.

The term –0.2 represents the slope of the regression line of median surface refractive index, Ns, on median path loss, L, from the data of many paths analysed by Yeh.

This dependence of path loss upon surface refraction index has been thoroughly investigated by Bean[7] and others, and Bean has published world contour maps of Ns season by season.

TABLE 1
Parameters Used in P.A.A. North Atlantic Range Tests from Shannon

Frequency	127 Mc/s
Airborne transmitter power	25 watts
Airborne aerial gain	0 dB
Ground aerial gain	18 dB
Ground aerial height	950 ft.
Ground receiver noise figure	6 dB
Ground receiver bandwidth	20 kc/s
Average altitude	30.000 ft.
90% reliability range:	
Measured	315 n. miles
Predicted	280 n. miles
Used in argument	300 n. miles

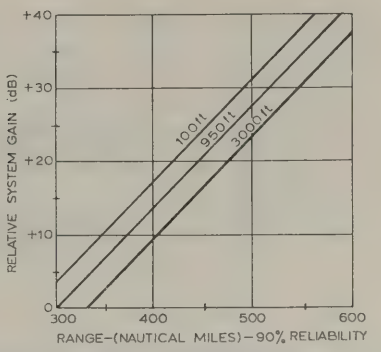


FIG. 5 — Effects of improving on the Parameters shown in Table 1

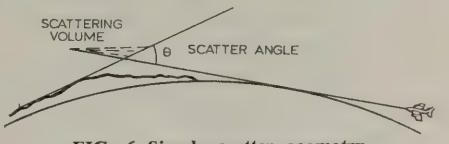


FIG. 6 Simple scatter geometry.

REFERENCES

1 L. A. AMES, E. J. MARTIN and T. F. ROGERS: "The airborne measurement of 1.3 m fields to ranges in excess of 900 miles and at altitudes from the surface to 40,000ft.," Electro-magnetic Wave Propagation. (Academic Press, 1960, p. 215.)

2. M. TELFORD: "Tropospheric Scatter System Evaluation," Journal Brit. I.R.E., Vol. 18, No. 9, p. 511, Sept. 1958.

3 L. P. YEH: "Simple Methods for Designing Tropospheric Scatter Circuits," Trans. I.R.E., CS-8, No. 3, p. 193, Sept. 1960.

4 W. C. VERGARA, J. L. LEVATICH and T. J. CARROL: "V.H.F. Air-ground Propagation Beyond the Horizon and Tropospheric Stability," Trans. I.R.E. A.P. 10, No. 5, p. 608, Sept. 1962.

5 E. H. BRUCE-CLAYTON and D. B. CLEMOW: "Long-range V.H.F. Air-Ground Communications," Journal Brit. I.R.E., Vol. 25, No. 1, p. 17, Jan. 1963.

6 G. A. ISTED: "Guglielmo Marconi and Communication Beyond the Horizon," Point to Point Telecommunications, Vol. 2, No. 2, p. 5, Feb. 1958.

7 B. R. BEAN and J. D. HORN: "The Radio Refractive Index Climate Near the Ground," Journal of Research N.B.S., Vol. 63D, No. 3, p. 259, Nov.-Dec. 1959.

Automatically-fed Computer

continued from page 26

by the computer.

Figure 1 shows a general view of the Autolector installation. The machine is 11' 1'' long, 3' 1'' wide, and 6' 3'' high. It consists basically of a fast conveyor system which picks up forms from pre-loaded cassettes, carries them to a reading head, and presents them in an output tray in the same order in which they entered the machine. At the reading head the graphic information on the forms is converted to electronic impulses and passed direct into the computer store.

Method of Operation

The mode of operation of the machine will be understood more clearly if reference is made to Figure 2. The sequence of operations can be controlled by push-buttons on the control panel. Pressing the appropriate button starts the conveyor belt and forms from the loaded cassettes are drawn by a vacuum pick-up and selector arm on to the conveyor at a constant rate of up to 400 forms per minute, depending on the size of the form. The documents to be read can be loaded into the cassettes and the conveyor belt continually fed without interfering with the running of the machine. The cassettes are adjustable to carry different-size forms and a counter-rotating double-feed preventer ensures that forms are picked up singly and separately.

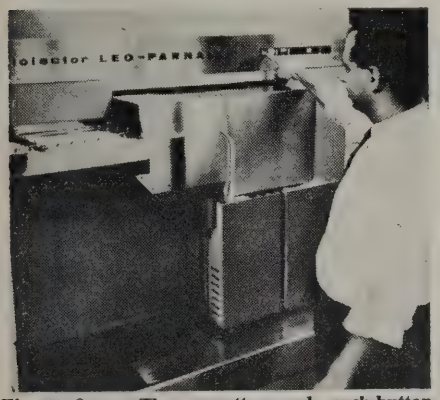


Figure 3 — The cassettes and push-button control panel of the Autolector. The operator is seen starting the machine.

Each form is then conveyed by a series of alignment rollers to a vacuum drum where it is held smooth and carried past the reading head. At the reading station the document is illuminated by two high-power tungsten-iodine lamps and the image of the data marks is projected through a high-quality lens on to a series of photoelectric cells which originate the signals for the computer. The document is then picked from the drum by another vacuum belt and taken to an output chute. A vibrator, triggered by the weight of the forms in the chute, stacks them neatly and in order.

The information from the reading station passes directly into the computer, where it is immediately put into store as part of the time-sharing arrangements which enable other jobs to be carried on while the data is being taken in.

Autolector can handle documents in either a small-size range —five inches by four inches to nine inches by six inches—or a large-size range—nine inches by seven-and-a-half inches to one foot four inches by eight-and-a-half inches—provided that the length is at least 25 per cent. greater than the width. The forms may have perforated edges or sprocket holes down each side.

Information may be stored on up to 16 columns set at a pitch of 0.30 inch. Lines can be spaced freely on a form, the minimum separation standard being 0.25 inch; under more closely controlled conditions lines can be spaced with a separation of 0.196 or 0.157 inch. The position of each line, and the significant marking area, is defined by a pair of location marks.

Two-Level Discrimination

The forms can be marked with black pencil (grades HB, H, or F); by computer printer; or by embossed plate. A mark is made by joining two points of a marking aid with a horizontal line. A number of different types of marking aid can be used. Marks are scanned across a width of 0.10 inch in the centre of each column. A variable two-level discrimination feature distinguishes between ''certain'' and ''doubtful'' marks. In preference to erasing any mark made in error, a cancel mark is entered by filling in the lower half of the rectangle formed by the line/column grid.

Figure 4 — The optical reading head and tungsten-iodine lamps of the Autolector seen in close-up.

Forms have already been designed and developed to gather data for payrolls, ordering, stock and production control, billing, hire purchase accounting, market research, and meter reading. The makers claim that there is no

Book Reviews . . .

British Computer Development

continued from page 33

limit to the range of work that can be handled by the system.

An Autolector was demonstrated at the Business Efficiency Exhibition in London (October 5 to 14, 1964), where it attracted considerable attention. The first orders for the Autolector system were placed by the British Government (for two), and by J. Lyons and Company Ltd. The Lyons machine has already been delivered and is operating with a LEO III computer. That company is a world leader in commercial data processing and its very advanced d.p. applications in the bakery, tea and ice-cream divisions have been made possible by the development of the Autolector system. The British Government's machines will be used in naval dockyards at Devonport and Portsmouth in conjunction with two LEO III computers.

In its present form, which is suitable for the existing range of computers, Autolector costs less than £25,000. Depending on the size of the documents, it can handle up to 14,000 large forms, or 24,000 small ones per hour. To punch and verify the same number of forms in an hour 200 girls would be required, and the annual cost of doing this job by hand, including depreciation of the equipment used over four years, would be £200,000. The corresponding cost for Autolector is £10,000 per annum.

Correction: In the circuit on Page 9 of the October issue in the article "A Transistorised "HI-FI" Tuner," a capacitor has been omitted. This is a .1 mfd. 100 volt working or similar and is connected between pin 5 of the second coil and the base of the second AF 116 Detector transistor. We would be grateful if readers would suitably amend their copies.

The first book we have for review this month is entitled "Micropower Electronics" edited by Edward Keonjian Consultant. Grumman Aircraft Engineering Corp, published by Pengamon Press, Oxford.

This is a very interesting collection of lectures presented in France, Germany, Italy and the U.K., by a group of distinguished scientists in the fields of solid state physics and solid circuitry.

Some of the topics discussed are — The relation between minimum required power density and frequency response for present and future semi-conductor triode amplifiers; the use of metal-oxide semi-conductor Field Effect devices for micro-power logic circuits; a micro-miniature digital integrator using micro-power circuits; the multiple emitter transistor in low power logic systems; the design of minimum power digital circuits for Mariner II and other spacecraft; and static and dynamic performance of micro-power transistor linear amplifiers. The book should prove of interest to those engineers and research workers working with semi-conductors as it gives an insight into the efforts made in solving some of the problems associated with the field of microelectronics.

Our copy by courtesy of the publishers.

The second book we have for review is entitled "Junction Transistors on Pulse Circuits" by P. A. Reeteson. Published as part of the Philips Technical Library by N. V. Philips, Eindhoven, Holland.

This is an interesting and useful text for use by anyone who is considering work with pulse circuits. The inherent properties of the transistor make it a more nearly ideal switch than the vacuum tube and therefore the discussion of the treatment is simpler than that for vacuum tube.

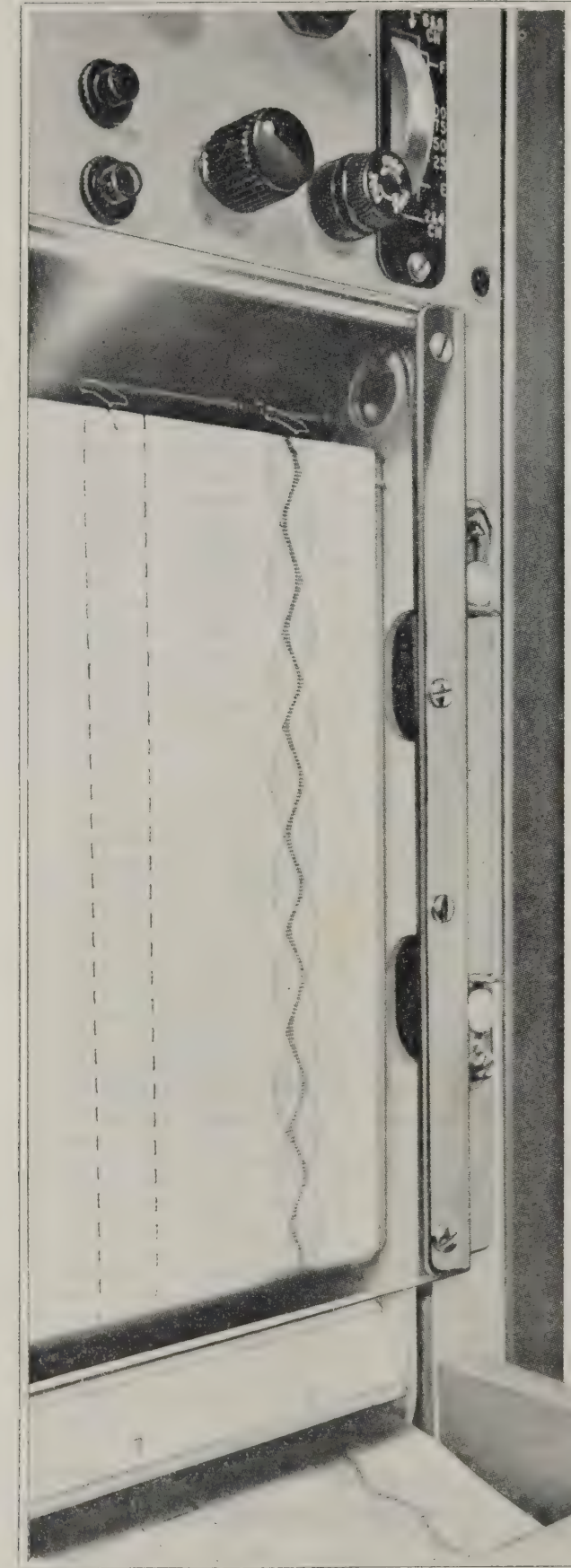
Following an introduction and discussion of various kinds of electronic switches, the text goes on to survey the fundamental pulse circuits. Pulse generators, pulse shapers, frequency dividers and voltage-level switches are next discussed in logical order and these are complemented by other auxiliary pulse circuits and logic circuits.

The text is written to interest as many readers as possible in the potentialities of semi-conductor devices and therefore does not delve too deeply into the mathematics or the physics of transistor operation. Also the text is well illustrated with clearly drawn figures and calculated examples are used to demonstrate the various formulae.

Our copy by courtesy of Philips Electrical Industries.

Editorial Note: We have received a number of enquiries about the availability of the Clevite Ceramic Transfilters which were used in the "Transistor Communications Receiver" published in the August 1964 issue of this journal. These filters are available from E. C. Gough Ltd., and their address can be found by referring to their advertisement to be found in these journals.

ENQUIRY CARD AD. 13



Recording Advantages

you get *only from Sanborn*

Sanborn **inkless, heated stylus** recording on matching Permapaper charts will give you a clear, permanent record of the signals **you want to record**—under **your conditions of use.** Every one of the performance characteristics listed below has been available from Sanborn for the last five years—and thousands of channels in use today are the best evidence that this is a **proven, practical** and **positive** means of recording. Here are the advantages it can give you in actual practice:

- **¼ division LINEARITY** (½% of 50 div. chart)
- **2.5 ms RISE TIME** (10 div. deflection, 10% to 90%)
- **4 cycles/mm RESOLUTION** even at small amplitudes
- **NO DOWN TIME** for filling reservoirs, priming, unclogging styli . . . no ink on your hands or clothes
- **TRUE RECTILINEAR WRITING** without linkages
- **NO PARALLAX ERROR or "NEGATIVE" TIME** . . . all styli contact chart along a fixed, common knife edge
- **NO LOSS OF WRITING AT HIGH OR LOW TEMPERATURES** . . . no pressurized, temperature-sensitive writing medium container
- **RELIABLE, SIMPLE, FIELD-PROVEN ELECTRONICS** use heavy current feedback without electromechanical transducers in the feedback loop

SAMPLE ELECTRONICS LTD.

8 MATIPO ST., ONEHUNGA, AUCKLAND, NEW ZEALAND

TELEPHONE 565-361

SANBORN COMPANY

INDUSTRIAL DIVISION
WALTHAM, MASS. 02154
A Subsidiary of Hewlett-Packard Company

Serviceman's Column

continued from page 23

functioned on both power and battery and did not blow any more fuses. There was no sign of a short circuit anywhere so I was rather at a loss to understand why an open circuit should cause a fuse to blow but nevertheless this was what had been happening.

Having got the set functioning I now found that although a picture could be received the various linearity and A.G.C. adjustments were in common parlance "all to Hell". To make matters worse there were absolutely no markings on any of the pre-set controls and even after the owner went home to see if he could find the instruction book it didn't help much as it was entirely in German.

As I had a smattering of German, I thought I'd have a go at a spot of translating and after a bit of head-scratching was able to identify the various pre-set controls. Of course some words were self explanatory—Kontrast for contrast, Tonblende for tone control being examples. Once I had discovered that "Bild" was "picture" and "Zielen" was "lines" it wasn't too hard to get vertical linearity from "bild-linearitat" and (line) width from "Zeilenbreite". Likewise "Zeilen-frequenz grob" turns out to be line-hold, coarse and "Bildkipp" (literally picture tip-over) to be frame-hold. From there on, with the help of the service manual, it wasn't too hard to get the pre-sets back to a fair semblance of their original settings. Sprechen sie Deutch, anybody?

CUT HERE

ADVERTISEMENT & PRODUCT ENQUIRY SERVICE

TO OBTAIN MORE INFORMATION ABOUT PRODUCTS OR SERVICES MENTIONED IN THIS ISSUE FILL IN ITS NUMBER, YOUR NAME AND ADDRESS, CUT OUT THE COUPON, AND POST IT.

1st FOLD

If you require your own subscription postage free each month fill in here — we will invoice you.

Please send me
RADIO, ELECTRONICS AND COMMUNICATIONS
for

12 months ... 30/-
24 months ... 50/-

NAME .....

ADDRESS .....

.....

3rd FOLD

BUSINESS REPLY POST

AUTHORITY No. 1231 AUCKLAND, N.Z.

Postage will be paid by
THE MAGAZINE PRESS LTD.
P.O. BOX 1365
AUCKLAND

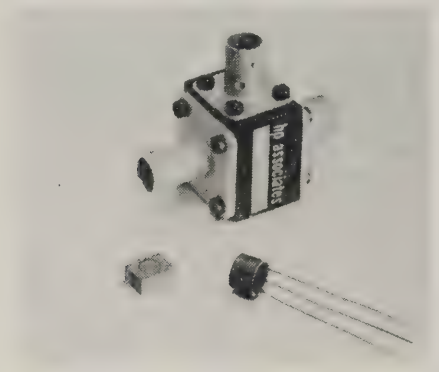
2nd FOLD

FIX HERE

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

WIDEBAND MICROWAVE SWITCHES

—hp associates—announces a new concept in wideband microwave switches now available in production quantities. This new development provides in a single switch a previously unattainable combination of low insertion loss, high isolation, and very wide bandwidth. The switch is hermetically sealed and designed to meet military environments.



The —hpa—3501A utilises direct integration of PIN diode chips into a microwave filter structure to provide a high performance miniature switch useful over a very wide range, from 0.5 to 12.4 gc. Embedding the uncased diode in the structure avoids parasitic reactances that accompany a discrete package and allows the switch to exploit fully the inherent frequency range of the diode.

The—hpa—3501A is a single-pole, single-throw switch and continuously variable attenuator providing up to 45 db isolation with less than 1 db insertion loss. The switch weighs less than 3.5 ounces and measures 1.06" x 1.00" x 0.75" not including the TNC connectors for the rf signal and the BNC connector for attenuation bias control.

The attached picture shows the —hpa —3501A compared in size with a standard TO-5 transistor. Also shown is a modified version of the —hpa—3501A, the —hpa—3502, which is designed for integration into stripline systems.

Price of the —hpa—3501A is set at 250 dollars for 1 to 10 in the U.S.A.

ENQUIRY CARD 87

* * *

NEW SYNTHETIC WIRE ENAMEL

A new synthetic wire enamel, which has five times better resistance to abrasion than oleoresinous coatings, is twice as hard, withstands higher temperatures longer, and costs only two-thirds as much as these coatings based on solids on wire, is being introduced by the Westinghouse Micarta Division, Trafford, Pa.

The new Micarta B-115 wire enamel is said to be equal or superior in many areas to Formvar wire enamel which costs three times as much, based on the amount of solids on wire.

The high endurance of B-115 enamel is shown by standard specification tests. In scrape test apparatus, a pressure of 42 ounces is required to remove the enamel with a single stroke. In the thermal flow test (MIL-W-583B) a temperature of 180 to 240 degrees C (depending on the degree of bake) is required for crossed wires to cut through while a 1000-gram load is being applied. In thermal stability tests at 130 degrees C, it takes at least 100,000 hours for dielectric twist failure. The B-115 enamel withstands heat at 155 degrees C for at least 10,000 hours before dielectric twist failure.

Other important properties of B-115 wire enamel are its high, 42-per cent content of solids and its ability to dip-coat as well as die-coat wire in sizes ranging from No. 6 to No. 54 gauge.

New Micarta B-115 wire enamel can be either die coated or dip coated.

ENQUIRY CARD 88

LITERATURE ON WESTINGHOUSE DIGITAL INSTRUMENTATION SYSTEMS

Literature, outlining the digital instrumentation systems used for high-speed measurements and control in the processing and material handling industries, is available from the Westinghouse Relay-Instrument Division.

The brochure discusses the features, systems operation, and advantages of the digital instrumentation systems when applied to the paper mill, steel and material handling industries.

For a copy of booklets B-8861 and DB-43-700, write to the Westinghouse Electric International Company, Transformer Meter and Relay Division, 200 Park Avenue, New York 10017, U.S.A.

ENQUIRY CARD 89

* * *

TOOL KIT FOR RELAY MAINTENANCE FROM WESTINGHOUSE

A tool kit for relay maintenance is available from the Westinghouse Relay-Instrument Division.

The kit comprises more than 40 essential tools for the normal maintenance, repair, and adjustments of Westinghouse relays.

It contains special wrenches, screwdrivers, burnishing tools, spring adjusters, and can be purchased as a complete set or individual tools to suit customer needs.

For more information, write to Westinghouse Electric International Company, Transformer, Meter and Relay Division, 200 Park Avenue, New York 10017, U.S.A.

ENQUIRY CARD 90

* * *

INVERTER-TYPE SCR'S DESCRIBED IN NEW BULLETIN

Fast-switching inverter-type silicon controlled rectifiers (SCR's) are described in a four-page bulletin available from the Westinghouse Semiconductor Division.

The bulletin describes the characteristics and applications of a line of inverter-type SCR's rated 4.7, 16, 55, and 110 amperes rms. Each unit is available in forward biasing voltages from 50 to 600 volts.

For a copy of bulletin 7964 describing this line of inverter type SCR's, write to Westinghouse Electric International Company, Semiconductor Division, 200 Park Avenue, New York 10017, U.S.A.

ENQUIRY CARD 91

* * *

NPN SILICON TRANSISTOR BULLETIN FROM WESTINGHOUSE

High quality NPN silicon power transistors at geranium transistor prices are described in a bulletin from the Westinghouse Semiconductor Division. These devices are for use by original equipment manufacturers in inverters, power supplies, magnetic drives, ignition systems, and amplifiers.

The six-page bulletin lists the maximum rating and electrical characteristics of each transistor in the series 151-152, 153-154 and 163-164. The 151-152 series transistors are available with collector-to-base sustaining voltages from 80 to 200 volts at six amperes. Collector-to-base sustaining voltages range from 65 to 225 volts for the 153-154 and 163-164 series transistors at 7.5 and 20 amperes respectively. Also included are a mechanical outline of each unit.

The advantages of lower costs, greater reliability, higher ambient temperatures, faster recovery, and longer life of silicon transistors are presented in a case history.

For a copy of descriptive bulletin B-7960, write to Westinghouse Electric International Company, Semiconductor Division, 200 Park Avenue, New York 10017, U.S.A.

ENQUIRY CARD 92

* * *

SIMPLIFICATION OF CONTINUOUS LEVEL MEASUREMENT

Fielden Electronics Ltd., of Wythenshawe, Manchester, have simplied the method of measuring levels in a large number of containers with the introduction of their Telstor 62 continuous level-measuring instrument. A potted solid state transmitting circuit has been incorporated into the head of the electrode, or sensing probe, with two transistor switches alternatively charging and discharging the capacitance of the probe. The probe is charged to a stabilised supply voltage and the mean discharge current is always directly proportional to the capacity of the probe; this in turn is proportional to the probe's immersion in the material. Combined with the Fielden "Bikini" dc potentiometer, with which the connecting wires can be up to 30 miles in length, the probe eliminates multiplication of wiring.

ENQUIRY CARD 93

* * *

IMAGE AMPLIFIER AS QUALITY CONTROL TOOL IN TURBINE BLADE PRODUCTION

A twelve-inch industrial image amplifier is now available from Marconi Instruments Ltd., of St. Albans, Hertfordshire. It is a high-definition, closed circuit television system which can be used for direct viewing of a fluorescent image produced by the passage of X-rays through a specimen. The image is focussed by a mirror and lens system on to the photocathode of a 4½ inch

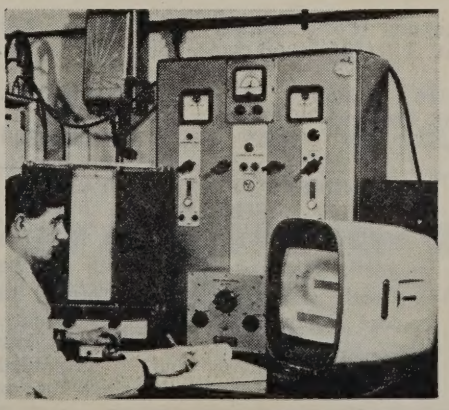


image Orthicon tube and is then displayed on one or more 17-inch television monitor screens. Electronic magnification enables these to have an 800-line definition in the central eight inches of the screen. Outlets are also provided to enable recordings to be made on video tape, 16 mm cine film, 100 mm negative film or 4 inches x 5 inches Polaroid positive film. It has already been ordered by a number of organisations for the examination of turbine blades. Each blade passes on a trolley between the X-ray source and the fluorescent screen, enabling a detailed examination to be made in less than five minutes. With a 250 kV source at 10 milliamperes steel up to 1½ inches can be examined visually, giving a sensitivity of 2%. The inspection unit itself is made radiation proof so that no special room or building is needed, and if a thicker lead lining is fitted a 300 kV source can be used. An interlocking device ensures that the X-ray tube cannot be energised with the cover open.

ENQUIRY CARD 95

* * *

LIGHT BEAM REPLACES PEN ARM IN OSCILLOGRAPH

An oscillograph which uses ultra-violet rays instead of a pen arm for direct recording of events in graph form has been developed by Southern Instruments Ltd., of Frimley Road, Camberley, Surrey. This technique, because of the reduction in writing arm mass, increases the maximum recordable frequency up to 10,000 c/s (with suitable galvanometers). Mechanical interference is also eliminated, allowing each trace to deflect to the full width of the recording medium. No cameras or chemicals are used and all that is necessary to develop the recording is to expose the paper to strong artificial light or daylight. It is then permanent unless exposed excessively to strong sunlight.

The oscillograph is the U-V type M.1300. Ten data channels carry the signal inputs, and either one or two reference or timing lines can be recorded simultaneously with the data signals. There are twelve paper speeds from 0.15 inch to 100 inch per second and these may be varied even during recording. A 100 watt mercury super pressure recording lamp is used and there is space for 150 feet of lightweight recording paper or 300 feet of the ultra thin type. Writing speed can be greater than 30,000 inches per second and timing lines to mark the edge of the paper can be at intervals of 0.01, 0.1 or 10 seconds.

ENQUIRY CARD 94

* * *

CLOSED CIRCUIT CAMERA FOR MAINS OR 12-VOLT BATTERY OPERATION

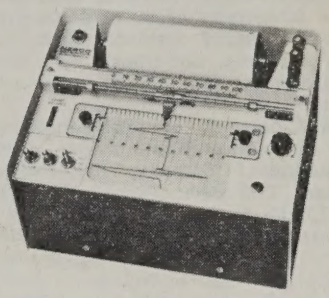
Since it can be operated either from ac mains or from a 12v dc battery, the new Type 8 fully transistorised closed circuit television camera now available from EMI Electronics Ltd., of Hayes,

Middlesex, can be used for television systems in many differing circumstances. The camera is completely self-contained, weighs only 10 lb, needs no external power unit and has only two cables, one for the power supply and one for connection to any television receiver, whether mains or battery operated. It has video output for precision viewing monitors, and RF output for domestic receivers and is available on 405, 525 or 625 lines standards. The standard unit includes a one-inch vidicon camera tube and a 1-inch f1.9 variable focus lens, but wide-angle, telephoto and other lenses may be fitted if required. High sensitivity enables good pictures to be displayed under normal lighting conditions, and with an "autolight" unit the range can vary from bright sunlight to normal room illumination. A remote camera control and a remote pan and tilt assembly unit are also available.

ENQUIRY CARD 96

NESCO "A" SERIES RECORDERS

New Nesco Instruments Model JY100A 10 mv, 5-inch Chart Recorder features 1/2 second response time, 0.5% accuracy, with new dual chart drive and capillary pen, and compact, rugged construction.



Zero location may be positioned, by panel control, any place on chart or up to ± 25% off-scale. Sensitivity is 0.25% of full span. Units are provided with floating input with separate chassis ground. Measurements may be made at levels up to 150v off ground.

Input impedance is essentially infinite at balance on most sensitive range.

Customers may select a single or dual speed unit with choice of one or two of 16 chart speeds. Mercury cell and zener reference systems, special power, bench or rack mounting, reversed polarity, event markers, special indicating scales, and a wide range of chart papers are available to fulfill exact customer requirements.

Dimensions: 9"D x 6¼"H x 11"W; (rack mounted—12¼"H x 19"W panel). Net weight is approximately 12lbs.

ELECTRO SCIENTIFIC INSTRUMENTS

The Model DT72A DEKATRAN Decade Transformer is a laboratory standard, transformer type ac decade voltage divider.

The first decade winding includes taps at —0.1 and +1.1 of input signal to give extended phase correction capability. The —0.1 input tap and the variable winding also provides two bridge arms for making direct reading impedance and admittance bridges.

Convenience has been added to precision by human engineering considerations which simplify dial setting and assure error-free in-line readings.

Direct reading current division with comparable accuracy can also be achieved with these units.

Other outstanding features are excellent long term stability, high input impedance, low output impedance, minimum phase shift, freedom from voltage coefficient, switching transient suppression and accuracy which is independent of environmental changes.

The DEKATRAN decade transformer is ideal for precise audio frequency voltage divider applications. Rigorously designed windings carefully placed on toroidal cores of exceptionally high permeability assure the maximum ratio of primary inductance to unbalanced leakage inductance. This high ratio provides outstanding transformation accuracy at low frequencies with no load.

The high primary inductance of the DEKATRAN divider makes it well suited for use in high impedance circuits without causing excessive loading.

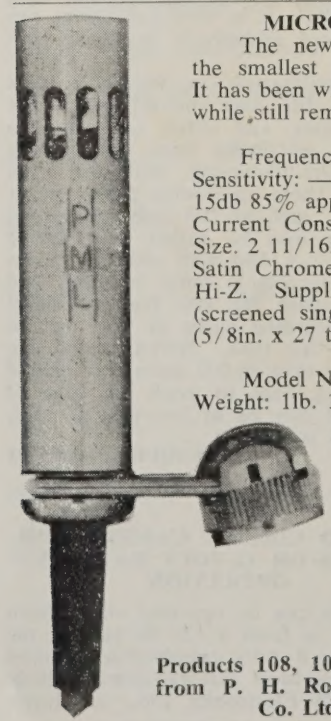
The accuracy of each DEKATRAN decade transformer is verified by precise calibration tests. The primary standard of voltage division is a special NBS calibrated transformer divider. DEKATRAN linearity is established by comparison with this transformer voltage divider. Tests show the Model DT71A linearity to be about 0.1 parts per million at 400 cycles per second. Intercomparison between similar DEKATRAN voltage dividers shows agreement to within 0.1 ppm.

The in-line control knob location on the DEKATRAN voltage divider permits rapid setting of the required value with a minimum of physical effort and visual attention.

The first dial has end stops to prevent accidental switching from zero to full output. Each of the other dials is free to rotate continuously in either direction so that setting time can be minimized.

The in-line reading reduces the probability of reading errors by presenting the value of the dial setting in a single horizontal line of seven digits, including the decimal point.

ENQUIRY CARD 101



MICROMINIATURE CONDENSER MICROPHONE

The new P.M.L. miniature microphone and power supply is the smallest professional microphone of its class ever produced. It has been widely used for the most critical professional applications while still remaining within the price range of the amateur recordist.

Specifications (Microphone)

Frequency Response: below 30 to above 18 kc/s ±3 db. Sensitivity: —52db (Model EK61) —50db (Model EC61). Directivity: 15db 85% approx. (for cardioid). Amplifying Tube: XFY54 HIVAC. Current Consumption. 10mA (Heater). 0.04mA (plate/polarizing). Size. 2 11/16in. length, 11/16in. dia. Weight: 1¾oz. Finish: Anodized Satin Chrome. Output Impedances: Choice 50, 200, 600 ohms or Hi-Z. Supplied with: 10ft. power supply cable, 10ft. signal cable (screened single co-axial conductor), clamp-on mike stand adaptor (5/8in. x 27 tpi).

Specifications (Power Supply)

Model No. 4315 — AC 110/125 V, 60 cycle. Size 4½in. x 2in. Weight: 1lb. 1oz.

Model No. 4316 — Battery- 1 -67½V, 1 -1.4V Mercury. Weight. 1 1oz. (batteries incl.).

CARD 108

Products 108, 109 available from P. H. Rothschild & Co. Ltd.

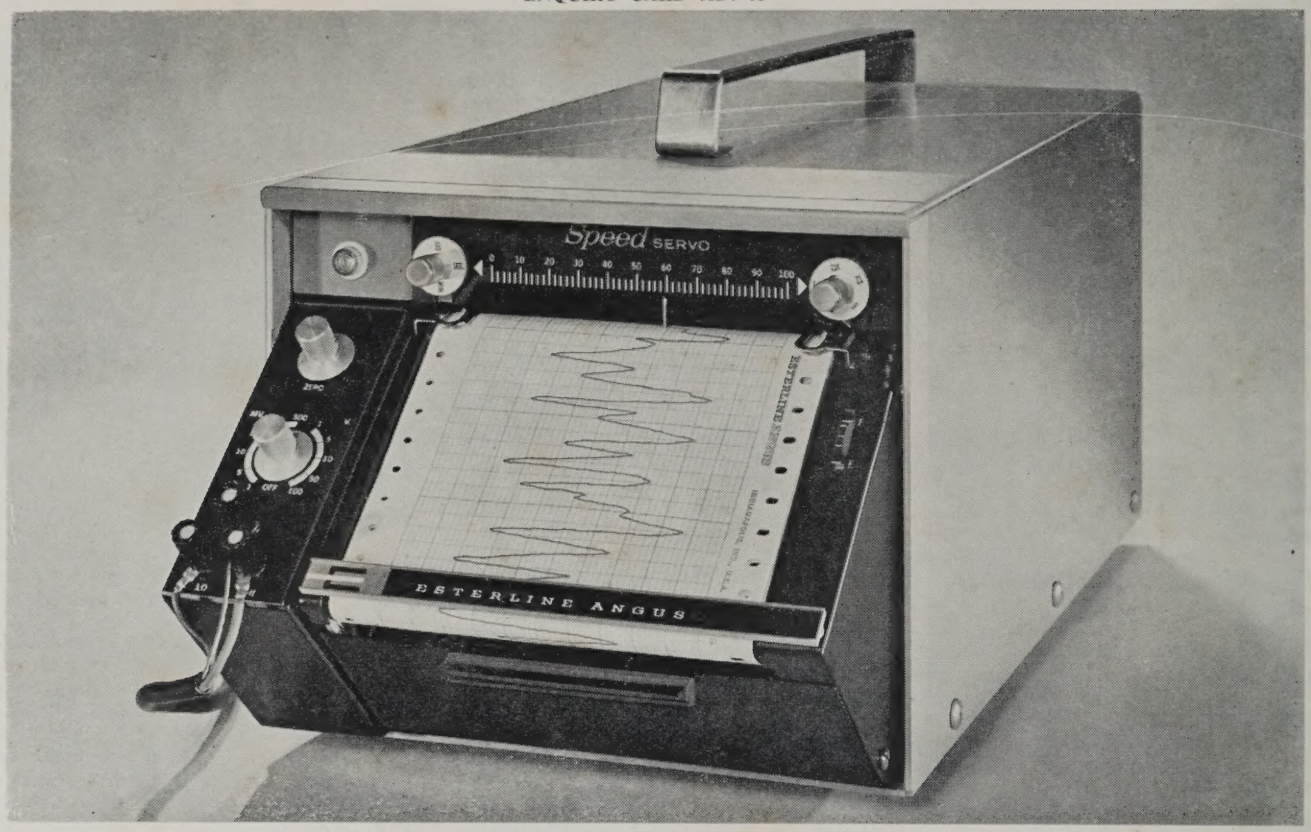
MAGNETIC/ELECTROSTATIC SHIELDS

Netic and Co-Netic flexible fails are magnetic shielding alloys which can be cut with scissors and hand formed to enclose components or small systems. They attenuate fields of high and low intensity respectively and, if grounded will provide electrostatic shielding as well. In some instances additional improvement can be obtained by interposing a non-magnetic separator between layers. Furnished final annealed and ready for use, both Netic and Co-Netic exhibit low retentivity and now shock sensitivity and can therefore be bent, formed, sheared or pierced without significantly reducing the shielding effectiveness.

CARD 107

Printed for the publishers, The Magazine Press Ltd., Employers Association Bldgs., 157 Khyber Pass, Auckland, C.3. Farrell Printing Ltd., 69 Carr Rd., Mt. Roskill, Auckland.

ENQUIRY CARD AD. 15



New Portable Speedservo

(fast, sensitive, simple, versatile)

New, high-speed, high-capability Portable Speedservo—another new generation "Graphline" instrument from Esterline Angus—designed to handle all your recording needs, tomorrow's as well as today's.

HIGH SPEED: $\frac{1}{8}$ second full scale response. Records 4 cycle signals without significant attenuation. SENSITIVE: 0-1 MV DC without jitter. Many higher ranges. Accuracy $\frac{1}{2}\%$. VERSATILE: Accommodates DC circuits with output impedance 100,000 ohms or less. Portable unit features sloped stainless steel writing surface. Chart tear-off bar. Full 6" wide 100' long chart. CONVENIENT: Dial 14 chart speeds from $\frac{3}{4}$ per hour to 6" per second. Input terminals, multi-range and feed selectors mounted at front for convenience. Hinged doors provide easy access to writing system and re-roll mechanism. LESS MAINTENANCE: Simple linear motion pen motor (unique shuttle type, not rotary); no strings, no pulleys. Zener reference voltage prevents hunting.

In addition to the new Speedservo, the radically new EA "Graphline" of rectilinear recorders include both single and two-channel DC Microammeters, DC Milliammeters, AC or DC Ammeters or Voltmeters, plus inkless and ink-type event recorders. Your inquiry is invited.

ESTERLINE ANGUS

Excellence in instrumentation for over 60 years

SOLE NEW ZEALAND AGENTS:

E. C. GOUGH LTD.

P.O. BOX 873 — PHONE 62-254 — CHRISTCHURCH

P.O. BOX 8150, Newton — PHONE 16-100 — AUCKLAND